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The role of collaborative relationships for product stewardship

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The Role of Collaborative Relationships for Product Stewardship

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J Miemczyk
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Dedicated to my wife Isabelle,

And our three children, Etienne, Alexander and Anaïs.

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Like the products that form the backdrop to this study, this thesis has had a lifecycle of its own, with a development phase, implementation phase and conclusion phase. During that lifecycle I have had the opportunity to benefit from guidance from a multitude of supervisors and advisers. For the first phase I would like to thank Paul Cousins for his challenging views on the research process (as well as feedback on an early draft of the thesis). During the middle phase I should thank Kate Blackmon (who also brought management research philosophy and methods to life) and Louise Knight for their comments and guidance on method. To conclude the study, I am indebted to Christine Harland and Helen Walker for their supervisory support and advice.

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ABSTRACT

This thesis focuses on the link between product stewardship, specifically end of life product recovery, and collaboration in business relationships. The European Union legislature has originated new regulations that affect product manufacturers and requires that companies establish end of life product recovery processes. New responsibilities for product manufacturers in turn lead to new business relationships that have to be managed. Previous research suggests that collaborative relationships are important for the success of end of life product recovery, and yet fail to describe how. Hence this research asks how collaborative relationships for end of life product recovery can lead to capabilities and, in turn, benefits for firms and society.

Based on empirical case analysis of six, recently established, collaborative relationships across three industries, the research explains the role of collaborative relationships in accessing and developing capabilities for end of life product recovery. The identified capabilities are linked to organisational and ecological benefits. The analysis utilises a conceptual framework and a number of theoretical lenses through which to explain the process of collaboration.

The research contributes to theory by using a conceptual framework that is developed into a conceptual model to predict the outcome of collaborative relationships for end of life product recovery. The contributions specifically target two identified research gaps relating to 1) the role of collaborative relationships in accessing and developing capabilities for end of life product recovery and 2) how the resulting capabilities lead to specific benefits. The work concludes that collaboration leads to both access and development of capabilities, with access more prominent in the relationships examined. While capabilities can lead to organisational benefits, such as reduced inventory, and ecological benefits, such as reduced landfill, this is not always the case. Furthermore, previous theoretical conceptions of product stewardship capabilities may be at odds with the competitiveness imperative.

CONTENTS LIST

GLOSSARY

ABS	Acrylonitrile Butadiene Styrene
ACEA	Association de Contructeur Europeanne Automobile
ACR	Arms length / Adversarial Contractual Relationships
ATF	Authorised Treatment Facility
BLIC	European Association of the Rubber Industry
COD	Certificate of Destruction
DEFRA	Department of Environment, Food and Rural Affairs
DFE	Design for the Environment
DFR	Design For Recycling
DTI	Department of Trade and Industry
E,H&S	Environment, Health & Safety
EC	European Commission
ECTEL	European Telecommunications and Professional Electronics Industries Association: A group of cellular phone manufacturers comprising Alcatel, Ericsson, Motorola, Nokia, Panasonic and Philips
EDI	Electronic Data Interchange
ELT	End of Life Tyre
ELV	End of Life Vehicle
EMAS	Environmental Management and Audit Scheme
EMS	Environmental Management System
EOL	End of Life
EU	European Union
FRDC	Franklin Research & Development
GM(E)	General Motors (Europe)
ICER	Industry Council for Electronic Equipment Recycling
ICT	Information Communication Technology
IDIS	International Dismantling Information System
IMP	Industrial Marketing Project
INTELLECT	UK trade association for the IT, telecoms and electronics industries
IOR	Interorganizational Relationship
IT	Information Technology
JV	Joint Venture
LCA	Life Cycle Analysis
MNE	Multinational Enterprise
OCR	Obligational Contractual Relationship
OEM	Original Equipment Manufacturer

PCB	Polychlorinated Biphenyls
PS	Product Stewardship
RAP	Relationship Assessment Process
RBV	Resource Based View
RL	Reverse Logistics
ROA	Return on Assets
ROHS	Restriction on Hazardous Substances
SMMT	Society of Motor Manufacturers and Traders
TCE	Transaction Cost Economics
TQM	Total Quality Management
TRI	Toxic Release Inventory
VRINN	(resources and capabilities that are..) **Valuable** to the firm, **Rare** to come by, **Imperfectly** mobile, **Not imitable** by competitors, and **Not substitutable**
WEEE	Waste Electrical and Electronic Equipment

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SECTION ONE

Chapter 1 Introduction

"We have in the past been concerned about the impacts of economic growth upon the environment. We are now forced to concern ourselves with the impacts of ecological stress – degradation of soils, water regimes, atmosphere and forests – upon our economic prospects. We have in the more recent past been forced to face up to a sharp increase in economic interdependence among nations. We are now forced to accustom ourselves to an accelerating ecological interdependence among nations. Ecology and economy are becoming ever more interwoven – locally, regionally, nationally, and globally – into a seamless net of causes and effects".

World Commission on Environment and Development, Our Common Future[1]

1.1 Background to the research

Society and natural environment are undoubtedly interdependent in a myriad of ways. Society is dependent on the natural environment as a source of basic materials and energy, and the natural environment is affected by social action, through changes to landscape or the composition of the atmosphere as examples. An inescapable consequence of social action is the generation of waste from economic activity, which changes landscapes, contaminates soil and water, and generates air pollution. Focussing on Western Europe shows that, if current trends continue, the volume of waste produced each year is expected to double by 2020 with commensurate effects on the natural environment[2]. While targets have been set by government to reduce this growth, levels of waste generation per capita per year are at a level of 550 kilograms, exceeding the

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[1] WCED [1987] Our Common Future, Oxford University Press, Oxford, p.5.
[2] European Environment Agency [2005] The European Environment: State and outlook, EEA Report, Copenhagen.

current target by 83%. This poses serious questions for society concerning how to balance economic activity and the resulting impacts on the ecosystems it relies upon.

In response to this challenge, firms that manufacture products (producers) have started to consider what happens to products when their traditional responsibility ends. This new and extended producer responsibility has led to the development of product stewardship strategies – the aim of which is to reduce the impact of products on the natural environment throughout their life-time (Guide Jr and Wassenhove 2002; Sharfman et al. 1997). Despite these developments by firms, legislation has progressed even faster outpacing the 'proactive' initiatives of firms (CEC 2000, 2001; Charter 1992), setting into place regulations that specifically control the take-back and recycling of products to standards not yet reached by industry (Knemeyer et al. 2002; Spicer and Johnson 2004; Toffel 2003; Walther and Spengler 2005; White et al. 2003). The strategic implications of these new regulations is perceived by industry to be huge, for instance, European automakers estimate their costs to comply to be in the range of 500-800 Million Euros per manufacturer[3].

By expanding the scope of responsibility of firms to end-of-life products, the traditional operational scope also changes. Figure 1-1 depicts an expanded scope of responsibility from manufacturing and use to waste management, re-use, remanufacturing and recycling.

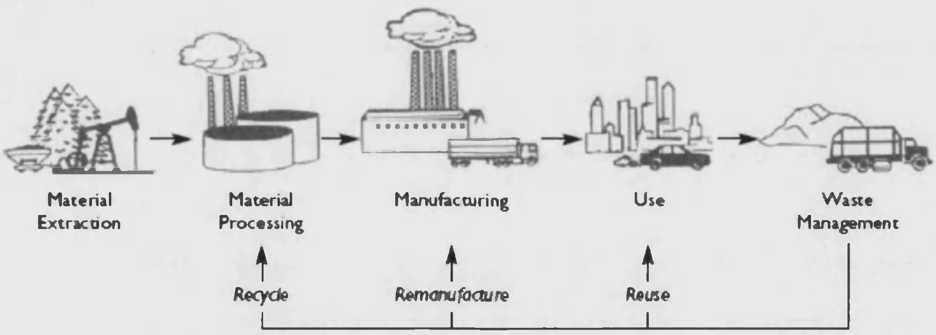

Figure 1-1 A scope of responsibility for manufacturing firms (Matthews 2004 p107)

[3] Based on a Cost of 150-180 Euro per car sold (Thomson, J 2002 Europe's controversial 'End of Life Vehicle Directive, http://www.just-auto.com/article.aspx?id=86928&lk=s, accessed 17 June 2002).

Alongside this change in responsibilities for the environmentally sound disposition of end of life products, firms are considering how to integrate these changes into their existing operations (Guide Jr and Wassenhove 2003; Mayers and France 1999; McIntyre et al. 1998; Whiston 1995). However, simply utilizing existing structures for supply chain management and logistics and distribution to recovery end of life products is often not an option (Seitz and Peattie 2004). Although there are linkages between forward and reverse supply chains, they are often very separate entities (See figure 1-2).

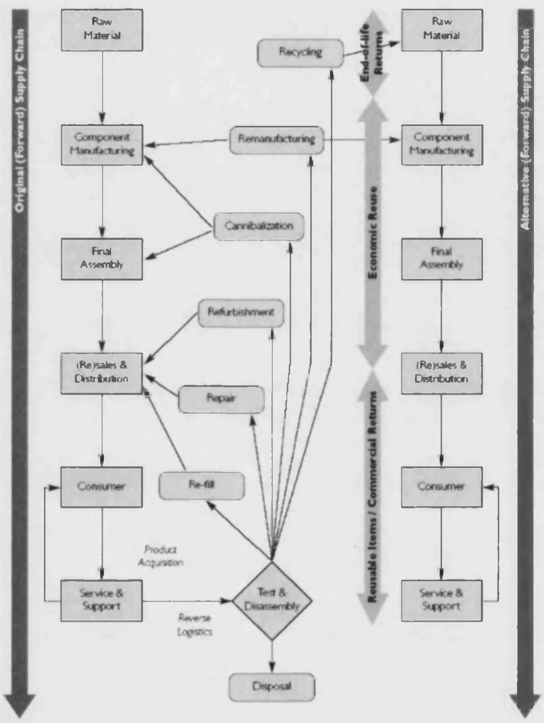

Figure 1-2 End of life product recovery process, the reverse supply chain compared with the forward supply chain (Krikke et al 2004 p27)

Furthermore, as firms are required to take on new responsibilities, it is unclear whether product manufacturers (often termed OEMs – Original Equipment Manufacturers) possess the necessary assets (physical, financial, skills and knowledge) to first, comply with new regulations, and second, ensure new responsibilities can be met without seriously harming competitiveness (Walley and Whitehead 1994; White et al. 2003). Given that product manufacturing firms often do not own the means to recover their own products at the end-of-life when discarded, firms have started to establish new relationships with firms that have acquired assets and developed skills for product recovery (Toffel 2003). Indeed, many firms have been engaged in these activities since the early days of industrial manufacturing, such as salvage operators, yet new regulations and social expectations will mean that new forms of organising these activities are needed. One approach to organising activities that span multiple firms is collaboration, yet little research has shown how this could be the case for product stewardship, especially in the area of end-of-life product recovery (Roy and Whelan 1992).

1.2 The research problem

Research in the field of corporate social responsibility (CSR) and corporate sustainable development (with constituent green practices such as pollution prevention and product stewardship) and how this relates to other managerial concerns such as organisational collaboration is an emerging theme in management literature. In the field of operations management in particular there is a continued need to develop researchable concepts and measures that can integrate these fields (Angell and Klassen 1999; Fischer and Schot 1993; Sarkis 2002).

Specifically the link between green practices and firm performance is still subject to mixed findings (Bansal and Clelland 2004; Melnyk et al. 2003; Walley and Whitehead 1994; Zhu et al. 2005). While recent research has begun to examine the mechanisms of this link, CSR, sustainability and green practices are multi-faceted constructs that include numerous variables (Bansal and Roth 2000). In particular product stewardship (PS) has received relatively little attention (Hart 1995), yet new regulations (e.g. European WEEE and ELV Directives) imply major effects on product manufacturer strategies (Guide Jr and Wassenhove 2003; Thierry et al. 1995; Toffel 2003).

The Resource Based View (RBV) is one perspective that considers a number of variables in the relationship between firm actions and performance i.e. sustainable competitive advantage (Barney 1991, 2001). RBV predicts that valuable resources and capabilities lead to competitive advantage (Wernerfelt 1984), and has been used to explain the link between CSR, sustainability (and related concepts) and performance (Aragon-Correa and Sharma 2003; Bansal 2005; Christmann 2000; Hart 1995; Hart and Ahuja 1996; Russo and Fouts 1997). Yet, firms do not only engage in product stewardship to gain competitive advantage, the need for legitimacy (meeting social norms such as regulations) also drive these actions (Jennings and Zanderbergen 1995;

Prakash 1999). This implies the need to integrate institutional thinking into research on product stewardship and combining RBV and Institutionalist approaches may provide some important insights (Bansal 2005; Oliver 1997).

Yet little is known about what happens if a firm does not possess the right set of capabilities for a given context, for example when the regulatory or competitive environment changes (Lavie 2006a). Firms may be able to develop or acquire capabilities and collaboration may have a role here (Hakansson and Snehota 1995; Jacobides and Winter 2005; McEvily and Marcus 2005). Therefore this research asks how firms that engage in PS (driven primarily by new legislation) can gain advantage and legitimacy through collaboration that allows access to or the development of capabilities for PS.

In particular product stewardship as a concept has been difficult to locate in the broader field of sustainable development and environmental strategies, with Hart (1995) making the first attempt to conceptualise how product stewardship forms part of corporate strategy. Bansal (2005) provides an integration of literature on corporate sustainable development linking in product stewardship concepts. Based on these authors, Figure 1-3 is an attempt to conceptualise how product stewardship and specifically end of life product recovery, the focus of this research, are located within the fields of sustainable development and environmental strategies.

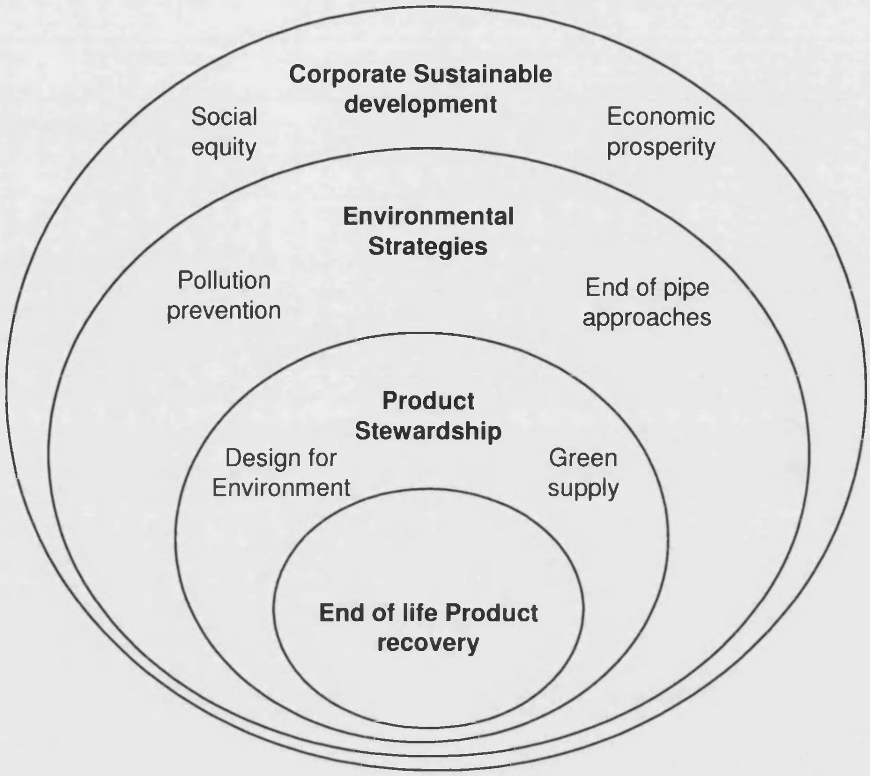

Figure 1-3 The relationship between corporate sustainable development, product stewardship and end of life product recovery (Based on Hart 1995 and Bansal 2005)

As figure 1-3 suggests 'end of life product recovery' is part of a number of product stewardship actions. To date the majority of research into end of life product recovery has been from a reverse logistics perspective (Guide Jr and Wassenhove 2002; Guide Jr et al. 2003; Prahinski and Kocabasoglu 2006; Stock 1998). While these studies have provided valuable contributions to mapping logistics processes and to an extent factors that affect performance (Carter and Ellram 1998; Dowlatshahi 2000; Stock 1998), the role of relationships and specifically collaboration has not been explained. This is surprising given the emphasis that supply chain relationships and collaboration have had in research into forward supply chains (Goffin et al. 2006; Lamming 1993), and despite some researchers indicating that collaboration is a vital factor in successful product recycling (Roy and Whelan 1992). In fact more recent work has called for a greater cross-fertilization of theory from forward supply chain thinking to reverse supply chains (Corbett and Savaskan 2003).

1.3 Aims of the research

The research is based on four core aims, in order to redress existing issues in the current literature on product stewardship and collaboration. As current literature spans multiple perspectives there is a need to consolidate this thinking selecting appropriate theoretical lenses. Therefore the first aim is as follows -

1) Provide an explanatory framework that links RBV and institutional perspectives, to examine how firms collaborate to access and/or develop capabilities for product stewardship.

In order to understand the role of collaboration within product stewardship activities such as end of life product recovery, it is important to assess the extent of these relationships. Thus a first empirical step is to map out the extent of collaboration between a firm and its network partners. For the purpose of this thesis collaboration has been defined as "*the process by which partners adopt a high level of purposeful cooperation to maintain a trading relationship over time*" (Spekman 1998: 77). There is currently no readily available sources of information on interorganisational relationships (IORs) in the area of product stewardship, whereby IORs are viewed as "*relatively enduring transactions, flows and linkages that occur among or between an organisation and one or more organisations in its environment*" Oliver (1990: 241). In order to provide a boundary to the research, and clearly state one of the limitations of this study, the scope is restricted to vertical relationships between firms. Although other types of collaboration exist, in order to build on a more restricted theory base, collaborations with public bodies, within firms, or with other non-economic stakeholders are not included in the study.

Furthermore, recent developments in end of life product recovery where "*the management of all end of life (used and discarded) products, components and materials that fall under the responsibility of the manufacturer (due to current or planned regulation)*" (Modified from Thierry et al. 1995: 114), mean that the field is in a state of flux. Hence the next aim was as follows

2) To map interorganisational relationships across a number of industries to identify the range of relationships and highlight collaboration.

In order to explain the role of collaboration and product stewardship the next logical step is to gather field data on collaboration and end of life product recovery to test whether the explanatory framework provides adequate theoretical scope. Previous research in the field has employed a variety of methods to build and test theory as shown in chapter 5. Despite this, the nature of this research problem (currently under-researched, focus on the relationship, rapidly changing domain) highlights the need to further develop theory and appropriate methods are needed to in order to do this. Thus the next stage is -

3) To test the conceptual framework and where possible extend it based on empirical research.

Once a rigorous framework has been established the research focus should also consider the relevancy of the problem (Pettigrew 1997). A core concern to businesses affected by new regulations and social expectations generally and ELV and WEEE Directive specifically, is how these affect their business processes. Providing an understanding of these implications provides a focus on relevance to business needs today. Thus the final aim is as follows.

4) Provide conclusions based on the conceptual framework, future directions for research and practitioner implications.

While it is not the intention of this study to examine the differences between reactive and proactive firms, it is recognised that much of the literature on environmental strategy has taken this approach. This study considers the drivers for adopting product stewardship as a means to understand the context within which firms organise collaborative relationships to meet product stewardship goals. As such it is not an aim of the study to distinguish between reactive and proactive responses, but to account for the influence of different drivers on the actions of firms (both in terms of opportunities and constraints).

1.4 Structure of the thesis

This thesis is divided into three sections covering (1) the background literature, (2) the development of a methodology and findings, and (3) ending with analysis and conclusions (as shown in Figure 1-5). Section one comprises of this introduction and a literature survey covering background literature to theories of the firm, the foundations of collaboration and product stewardship topics. Chapters 2 synthesises the management literature concerned with collaborative relationships providing explanations of the boundary decisions of firms, the meaning of business relationships and the nature of collaborative relationships. The section continues with literature specific to product stewardship in chapters 3. This chapter deals with concepts related to corporate social responsibility, sustainable development, product stewardship and end of life product recovery.

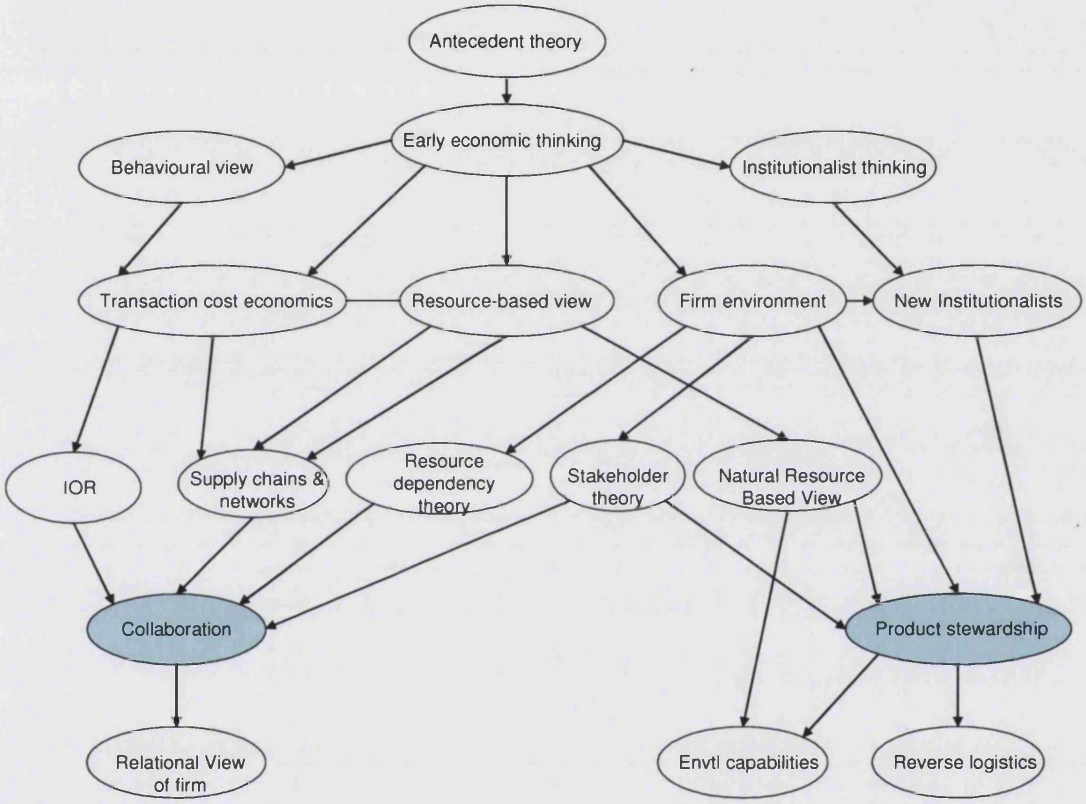

Figure 1-4 Scope of the literature review

Section two follows with three chapters detailing a conceptual framework and the research questions that are aimed at filling gaps in the literature, the research methodology chosen and the key findings. Chapter 4 summarises the main literature and develops a conceptual framework from which as number of research questions arise. The methodology in chapter 5 provides a view on research perspectives, methods previously used in the research area, a justification for the approach taken in this research and a detailed research design including case study protocol. The findings in chapter 6 start with the pilot case then describes the six relationships within the three case studies, set within three different industries. Each case is described with a common structure that was adopted in the case study protocol to aid comparison.

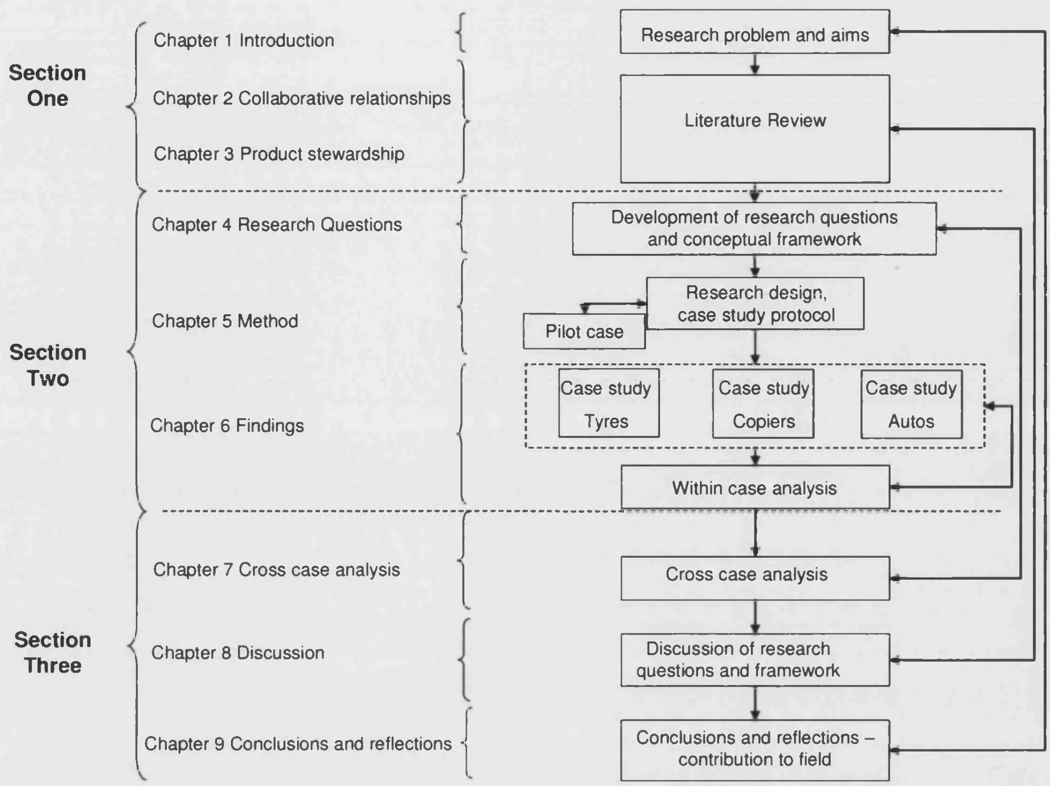

Figure 1-5 Structure of the thesis

The aim of section three is to reconcile the analysis of the empirical data with the theoretical foundations set in section one. As such, section three starts with Chapter 7 providing a cross case analysis by comparing each case and each relationship within each case, allowed by a set of defined criteria: drivers, relationships characteristics, capabilities and organisational and ecological benefits. The discussion chapter 8 answers the research questions, and re-visits the conceptual framework developed in chapter 4. Chapter 9 concludes the study by detailing the author's contribution to knowledge and reflects back on the literature discussed in section one and the overall research context. The chapter also details implications for practitioners and policy makers in two distinct parts. The conclusion chapter ends with the author's commentary on the research process, methodological limitations and future research.

Chapter 2 Collaborative Relationships

2.1 Introduction

This chapter reviews the main contributions to the understanding of collaborative relationships. Specifically, the chapter discusses the management literature in the areas of inter-organisational relationships, theoretical perspectives on business relationship (including transaction cost and resource based views) collaboration in its various forms, the impact of collaboration on knowledge and innovation. The chapter examines what collaboration is, why it occurs and what the implications and benefits of collaboration are? It is argued that these explanations are key to understanding the decisions to collaborate and how this relates to the outcomes of product stewardship. Specific links to product stewardship are reserved for the subsequent chapters on product stewardship and development of the conceptual framework.

In order to provide a research setting for collaboration this chapter first defines business relationships in general before expanding the thinking of relationships to include transaction cost economics (TCE) and the resource based view of the firm (RBV). TCE provides much of the economic background for the existence of firms and why some activities are left for market transactions. These market transactions are often less clearly defined than traditional economics would expect, and the literature review shows that a variety of forms of relationships have emerged such as hybrids, with many explanations for this variation. The RBV and competence-based explanations have also shown why it is that organisations carry out some functions and not others, in order to specialise in rent generating activities. The chapter goes on to provide a discussion of relationship models in order to achieve specific outcomes. This leads into a discussion of the role of collaborative relationships in knowledge and innovation management, key research themes in the literature.

The table (2-1) below describes the structure of the chapter and main theoretical contributions to the 'what?', 'why?' and 'implications?' of collaboration. The first section describes interorganisational relationships in a broad sense, as it is relationships that are the basis for collaboration.

Table 2-1 Literature contributions on collaborative relationships

Literature	Topic	Author	Contribution
Antecedent explanation of vertical scope	Transaction cost economics	Coase (1937)	Firms exist to economize on the cost of transacting
		Williamson (1975)	The role of opportunism in assessing transaction costs, asset specificity and small numbers
		Ghosal and Moran (1996)	Opportunism may not be as prevalent as Williamson suggests
	Resource based view of the firm	Penrose (1959)	Assets used for competitive advantage
		Wernerfelt (1984)	The resource based view
		Barney (1991)	The resource-based theory
		Priem and Butler (2001a; 2001b)	Criticise the resource based view
		Jacobides and Winter (2005)	Boundary choices and capabilities
	Behavioural theory	Simon (1957)	Bounded rationality
		Cyert and March (1963)	Behavioural theory of the firm
Interorganisational relationships (IORs)	Definitions	(Oliver 1990; Ring and Van de Ven 1994)	Definitions of IOR
		(Lamming 1993)	IOR as a quasi-firm
		(Cousins 2002)	IOR as a process with an outcome
	Outsourcing and supply chain	Coase 1937	Firms buy due to low TC
		Williamson 1975	What determines make/buy
		(Hakansson 1982)	IMP model of relationships
		(Helper 1987; Sako 1992)	ACR/OCR - Exit/Voice - trust
		(Lamming 1993)	Modes of supplier relations
		(Lonsdale and Cox 1998)	Reasons for outsourcing
		(Dyer and Singh 1998)	The relational view
Collaboration	Definitions	(Spekman 1998) (Hardy and Phillips 1998)	Definitions of collaboration
		Goffin et al (2006)	Characterisation of close relationships
	Types	(Harrigan 1985)	Joint ventures
		(Kanter 1994)	Alliances
		(Harland 1996; Jarillo 1988) (Nohria and Eccles 1992)	Networks
		McEvily and Markus; Zaheer and Bell (2005; 2005)	Networks as sources of advantage
		(Kirby 1988)	Trade associations as information exchange
	Benefits	Chen et al (2004)	Close relationships, better financial performance
		Johnstone et al (2004)	Cooperative behaviours, improved performance
	Knowledge	(Polanyi 1958)	Explicit and tacit knowledge
		(Nonaka 1994)	Model of knowledge creation
		(Hall and Andriani 2002)	Knowledge in innovation
	Innovation	(Abernathy and Utterback 1975)	Trends in innovation
		(Chesbrough and Teece 2002)	Autonomous and Systemic innovations

2.2 Theoretical explanations of vertical scope

Vertical scope refers to the extent to which certain activities are integrated into firms and other activities are left for market transactions (Jacobides and Winter 2005). It is the decision on vertical scope therefore that determines which relationships will be established between firms. While supply chain literature often discusses more practitioner-based explanations for interorganisational relationships (IORs), for example Lonsdale and Cox (1998), inter-organisational relationships are also described in the management literature from a number of different perspectives and these include TCE, resources dependency, strategic choice, stakeholder theory, organisational learning and institutional theory (Barringer and Harrison 2000). Although these numerous theoretical perspectives provide a variety of explanations, recent research has tended to focus on two perspectives: transaction cost economics and the resource based view (Chen et al. 2004; Das and Teng 1998, 2000; Jacobides and Winter 2005; Madhok and Tallman 1998; Martinez and Dacin 1999). The next two sections provide a brief discussion of these two perspectives.

2.2.1 Transaction Cost perspectives

Transaction cost economics (TCE) has primarily been used to explain firm existence showing that firms can become more efficient by economising transaction costs, determining when certain activities should be outsourced[4] and when they should be kept 'in house' or integrated (Williamson 1975). The definition of transaction costs originate from Coase's (1937) descriptions of the cost of using the price mechanism and that

> *"in order to carry out a market transaction it is necessary to discover who it is that one wishes to deal with, to inform people that one wishes to deal and on what terms, to conduct negotiations leading up to a bargain, to draw up the contract, to undertake the inspection needed to make sure that the terms of the contract are being observed and so on" (Coase 1960: 17).*

They have also been described as "*the cost like those of getting large numbers of people together to bargain, and the cost of excluding free-loaders*" (Calabresi and Melamed 1972). The understanding of transaction costs led to an understanding of what firms buy, produce or sell and therefore their size and existence. This is explained by the rule that if the costs to organise a number of transactions through the market are greater than the cost to co-ordinate the activities centrally, then the firm (later defined as a hierarchy in the literature) will emerge to carry out these activities (Coase 1937). This explanation is also proposed to explain why it is that firms grow larger or smaller. As a firm integrates more transactions it grows larger and as it leaves more transactions to the market it reduces in size. This is not a simple relationship however, as Coase (1937) explains that in fact there are also size limiting factors involved such that the costs of internalising transactions increase with the number of transactions, best use of production is reduced with more transactions and also the cost of employing people may rise as the size of firms increases.

TCE was taken further as a view of understanding the actions of firms (and their creation) by Williamson (1975) explaining that viewing firms through transactions and not only as production functions, provides the opportunity to examine the extent and actions of firms. The most significant contribution of Williamson is that while transaction costs are a very useful way of understanding firms, the analysis has to include the influence of human behaviour (Williamson 1975). Specifically, human behaviour was understood in terms of opportunism and bounded rationality. Bounded rationality from Simon (1957), is an important concept to understanding the actions of firms, as managers will be limited in decision-making by shortcomings in knowledge and the transfer of information (information asymmetry).

> *"The capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required for objectively rational behaviour in the real world" was the key definition of bounded rationality developed by Simon (1957: 64).*

Williamson also saw decision-makers as acting opportunistically. Complex contracts are needed in order to control for the influence of these factors in the market and Williamson argues that hierarchies (firms) can be effective to control these issues of opportunism and bounded rationality, compared with the costly price mechanism of markets.

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[4] Outsourcing refers to the process of removing internal activities from a firm and transacting with the market to obtain the outputs of these activities.

The second key assumption of TCE that Williamson makes is that of opportunism or *"self-interest seeking with guile"* (1975: 26). Again the advantage of hierarchy (the firm) in reducing the impact of transaction costs are that costly, complex contracts and monitoring activities are not needed to the same extent if the activities are internalised to firms.

Thus, following from this Williamson states that *"transactions are conducted under conditions of uncertainty, complexity in which it is very costly, perhaps impossible, to describe the complete decision tree"* (1975: 23).

The concepts of uncertainty and risk are also key to understanding the existence of firms according to Coase (1937). In particular firms are proposed to be able to deal with transactions more effectively, than pure market mechanisms because the uncertainty of dealing with volatile and risky transactions is removed through internal co-ordination. Thus uncertainty (in market transactions) is given as driver for the creation of firms. In fact the assumption of certainty is seen in two forms within the TCE perspective: unpredictability of the environment, technology and demand, and uncertainty about the behaviour of other firms involved in a transaction. A third behavioural assumption is risk neutrality which Chiles and McMakin (1996) claim has been neglected, but should have equal status with bounded rationality and opportunism in the explanation of TCE (this issue is returned to in the following criticism of TCE). For example Rindfleisch and Hinde (1997) ignore risk neutrality in their discussion of TCE due to the lack of empirical studies related to it.

Three key factors affect the impact of bounded rationality and opportunism and thus are important to the analysis of firms from the TCE perspective. These factors are asset specificity, uncertainty in transactions and frequency of transactions. Asset specificity is defined as *"durable investments that are undertaken in support of particular transactions, the opportunity cost of which investment is much lower in best alternative uses or by alternative users should the transaction by prematurely terminated"* (Williamson 1985: 55). Williamson states that opportunism is more likely if the buyer and supplier firms are locked-in through assets which are specific to the transaction. Therefore the costs to control this opportunism are less if the transaction is internalised and controlled by the hierarchy. Types of asset specificity include site specificity, physical asset specificity and human asset specificity as well as dedicated asset specificity where for example a supplier may have equipment or personnel dedicated only to one particular customer (Williamson 1985).

Furthermore, TCE explains that there are increased transaction costs associated with environmental and behavioural uncertainty. Environmental uncertainty leads to high complexity and costly agreements which may also face high renegotiation costs through the time of a transaction. If the behaviour of a partner is uncertain then costs related to monitoring contractual performance of an exchange partner, when bounded rationality is present, can increase. Williamson qualifies these conditions by stating that uncertainty as a factor in TCE is only relevant when the transaction involves specific assets (Williamson 1985).

The third factor, transaction frequency is argued to reduce the cost impact of asset specificity factors. The costs associated with asset specificity (risks of opportunism) reduce when repeated transactions occur, or as put by Williamson *"the cost of specialised governance structure will be easier to recover for large transactions of a recurring kind"* (1985 p.60). Research has shown, empirically, that the frequency of inter-firm exchange improves the utilisation of specialised co-ordination arrangements for inter-firm relationships and that as asset specificity increases the influence of frequency further reduces costs (Buvik 2000).

From a research perspective, the measurement of transaction costs is a significant challenge to management scholars, as Grover and Malhotra (2003: 10) state *"it is almost impossible to obtain an accurate representation of these costs from financial data"*. Grover and Malhotra determine that an effective way of gauging these costs is through subjective, perception-based measures of the costs of developing a relationship with a supplier, the cost of monitoring supplier performance, the cost of addressing problems that arise and the likelihood a supplier will take advantage of the relationship (due to an underspecified contract)

TCE provides a thorough explanation for why firms exist and their extent through the examination of transactions. Due to the usefulness of this perspective its application to supply strategy and industrial marketing has received a great deal of attention (for examples see Bensaou 1997; Dyer 1996; Dyer and Singh 1998; Grover and Malhotra 2003; Jap 2001). Yet, despite these applications, this perspective is limited and a number of criticisms have emerged.

2.2.2 *Critique of TCE*

One of the main criticisms of TCE is that it over-simplifies the decision within firms to expand or contract (Barringer and Harrison 2000). There are instances when longer term arrangements such as franchising make the distinction between the firm and the market much less clear (Klein et al. 1986). It has to be noted that Williamson did respond to this criticism by recognising that hybrid forms, between firm and market, were possible and are not excluded in the TCE view. In Williamson's 1991 paper, hybrids are also defined by their transaction attributes and exist between the polar forms (market or firm) where long term contracting with bilateral dependency is supported by specialised governance features such as reciprocity. The attributes of the transaction are tied to the presence of unanticipated disturbances i.e. uncertainty. Williamson posits the view that hybrids exist where, asset specificity is intermediate, but as uncertainty increases these forms are less likely to occur due to the need for mutual consent of any response to uncertainty.

A further criticism of TCE was developed by Ghoshal and Moran (1996) and concerned the assumption made by TCE that opportunism is prevalent and leads to increased transaction costs. Ghoshal and Moran (1996) explain that opportunism actually varies across firms and may not be as widespread as predicted by TCE. Hill (1990) concurs with this, stating that hierarchies are not always necessary to safeguard against opportunism, as its occurrence may be limited by factors such as risks to reputation and possibilities of detection of the opportunistic firm. Further to this, control mechanisms (hierarchies or complex contracts) to reduce opportunism are reported to actually exacerbate problems by creating negative feeling within firms (Ghoshal and Moran 1996).

A related criticism concerns another of the behavioural assumptions of TCE, that of risk neutrality. Chiles and McMackin (1996) debate the relevance of including a range of risk preferences (risk avoidance, risk neutrality and risk seeking) in order to specify the explanatory power of TCE. For example they argue that different levels of trust and risk preference will affect the degree to which asset specificity increases governance cost. Thus interactions with trusting and risk seeking transactors will maintain lower governance costs for a given asset specificity level. This can be compared with interactions with no trust and risk averse transactors, where there is much greater governance cost for an equal level of asset specificity.

Furthermore, Demsetz (1993) challenges the TCE assumption that firms act as production functions equally well. As the information available to firms is not full or free concerning transactions (raising transaction costs), information is equally incomplete and costly regarding production. Thus firm's ability to produce also varies, explaining that transaction costs do not completely account for why firms differ.

In summary of the main criticisms, efficiency and cost-minimisation, as emphasised by TCE, is a limited view on how and why firms create particular governance structures both internally and with the market, as other factors such as learning and legitimacy have a role to play (Madhok and Tallman 1998). Other factors also determine the actions of firms such as government involvement, taxes and belief systems (Martinez and Dacin 1999). Reference to criticisms related to internal factors of firms and their importance as production functions, brings the debate to resource-based perspectives on the firm. In this case internal resources (or specialisation) account for differences in firm performance and not just the ability to reduce transaction costs (Demsetz 1993). This leads to the explanation of the actions of firm (attempting to rectify the over-emphasis on transactions as the principle means of obtaining efficiency), by concentrating on internal resources and how they can lead to competitive advantage.

2.2.3 Resource-based perspectives

Conner (1991) proposes that the main distinction between TCE and the resource-based view is that TCE concentrates primarily on the avoidance of opportunism, whereas the RBV focuses on the deployment and combination of specific inputs. While Mahoney (2001) provides further critique of the differences between TCE and the RBV, the critical arguments will follow a background discussion of the resource-based view.

The scholastic home of the RBV is predominantly management strategy, where strategy is seen as the fit between a firm's unique resources and its relations to its changing environment to attain the best performance (Reve 1990). It must be emphasised here that the resource-based view is not explicitly a theory, but a perspective by which to understand the comparative success of firms in a competitive market, although Barney does claim to develop the rationale into a theory (1991). Furthermore Mahoney (2001) states that RBV supports a more general resource-based theory comprising a number of other perspectives including capability and competence-base theory.

Resources, which provide the foundation to this view of the firm, have been defined as anything which could be thought of as a strength or weakness of a given firm (Wernerfelt 1984) or anything that enables the firm to conceive of and implement strategies that improve its efficiency and effectiveness (Barney 1991). However the most commonly used definitions describe resources as valuable, rare and difficult to imitate or non-substitutable, which helps explain why firms can use them to their advantage (Barney 1991; Wernerfelt 1984).

The origins of the RBV can be linked to the theory of growth of the firm which concentrates on the administrative control of productive assets that can be applied to various markets. For instance, firms diversifying into markets can create additional growth (Penrose 1959). The key concept here is the administrative control of productive assets, viewed as resources, and how they are best used. Penrose (1959) goes on to argue that the main economic function of the firm is to make use of productive resources for the purpose of supplying goods and services to the economy. Therefore the firm can be seen as a collection of productive resources. These resources include tangible assets such as land and plant, but also human assets and expertise. The administrative control then is crucial to competitive advantage, as managers must have the required competence to deploy these assets to the most productive use.

Clearly these definitions emphasise the role of resources in the understanding of competitive advantage and much of the literature taking the resource-based view (RBV) of the firm look to this issue as opposed to why firms exist per se (unlike TCE which explicitly takes this perspective). The exception here may be specialisation theory which suggests that as transaction costs reduce as firms subdivide into their relative specialisms to allow economies of scale in the particular area (Demsetz 1993). However, the growth of firms has been a focus of some of this work examining resources, and this is exemplified by the work of Penrose (1959).

A related concept to resource is capability. Capabilities have been defined as the internal and external organisational skills, resources and functional competencies developed within firms to match the requirements of the external environment (Teece 1987; Teece et al. 1997). Others have viewed capabilities as the things that shape what a firm can do in response (Barney 1991; Winter 1987). They have been described as being tacit, socially complex and rare (Dierickx and Cool 1989) or that they account for the diverging strategies in response to opportunities (Nelson and Winter 1982). More recent definitions of capability include *"a high level routine (or collection of routines) that, together with its implementing input flows, confers upon an organization's management a set of decision options for producing significant outputs of a particular type"* (Winter 2003: 991) or *"a capacity to integrate, combine, and deploy tangible and intangible resources through distinctive organisational processes in order to achieve desirable objectives"* (Lavie 2006a: 153). There are clear links to the RBV theory of Wernerfelt, but in this case capabilities appear to incorporate resources and how they are deployed.

Using the basic arguments of RBV, Prahalad and Hamel (1990) argue for the identification of the core competence of firms, when this should be a focus of top management coordination. They state that *"core competencies are the collective learning in the organisation, especially how to coordinate diverse production skills and integrate multiple streams of technologies"* (1990: 82). Thus for firms to win competitive advantage they should build and acquire core competencies.

The resource-based view taken as a whole incorporates a number of concepts, resources being core to these concepts but including capabilities and competencies. The RBV provides an explanation for how firms achieve competitive advantage through the deployment of idiosyncratic resources that competitors do not possess and are not able to imitate. Although this view has been widely used in the management literature, the RBV has been subject to numerous criticisms as discussed in the next section.

2.2.4 Critique of the RBV

Priem and Butler (2001a; 2001b) criticise Barney's 1991 exposition of RBV by explaining the theory is tautological, that value could be created by a variety of resource combinations (equifinality), the role of product markets is underdeveloped and finally that the theory is limited for prescription purposes. Barney refutes these claims by stating for example that all strategic management theories could be explained as tautological and that equifinality is actually addressed in his 1991 article (Barney 2001).

Further important criticism of the RBV relates to how opportunism - as described by TCE - is assumed not to exist (or at least not considered). Mahoney (2001) argues that in fact firms act in superior ways to market contracts because opportunism exists, causing differences to occur (i.e. heterogeneity). In the absence of opportunism, cultures and routines would be the same whether by market contracts or by firms (ceteris paribus), thus the existence of opportunism raises the possibility of differences. Mahoney goes on to argue that TCE and RBV are in fact complementary. Although RBV is concerned with firm rents, whereas TCE is a theory of firm existence, the very market frictions that explain firm existence are proposed to be the same market frictions that explain superior rents. Madhok and Tallman (1998: 330) support this view by stating that *"the very characteristics which make tacit resources valuable, such as complexity, causal ambiguity, and, in general, organizational embeddedness...also complicate the transaction"*, thus raising transaction costs.

Reve (1990) attempts to provide an integrated model of strategy that incorporates the RBV elements of a strategic core governed by internal contracts and strategic alliances based on external contracts (using the TCE rationale for which resources should be obtained through external contracts). Thus Reve (1990) forms a view of firms as a nexus of internal and external contracts. However issues of uncertainty are not discussed due to "imprecise operationalisation" limiting the application of a TCE rationale. The core skills that Reve discusses are defined with relation to asset specificity, but these are not defined in terms of core competencies or capabilities which are concurrent concepts at that time.

Other problems also arise from the RBV's internal perspective of firms. Firstly, firms are not in total control of the capabilities and resources required especially those external to firms (Aragon-Correa and Sharma 2003; Pfeffer and Salancik 1978). Mathews (2003) criticises the RBV focus on non-imitability, non-transferability and non-substitutability of resources, explaining that the evolutionary approach relies on these attributes of imitability and the like. Success relies on 'leveraging' resources from firms through open market transactions, interfirm alliances and contractual relations. A second point is that the environment that firms must deal with is not stable but uncertain and so firms' success can also depend on how they react to uncertain environments as emphasised by the behavioural theory of the firm (Cyert and March 1963; Lawrence and Lorsch 1967).

2.2.5 The behavioural view of the firm

The behavioural view of firms is encapsulated in Simon's Nobel lecture of 1978 (1979: 501) where he states

> *"the elaborate organisations that human beings have constructed in the modern world to carry out the work of production and government can only be understood as machinery for coping with the limits of man's abilities to comprehend and compute in the face of complexity and uncertainty"*

Thus the key factor considered in the behavioural theory of the firm is that humans are intendedly rational but only limitedly so (Simon 1957). The behavioural theory of the firm is a useful perspective here and is seen as being about the process of decision-making through the setting of goals, expectations and choice-making procedures (Cyert and March 1963). This process is key to understanding how and why certain actions take place and not others i.e. the selection and rejection of alternatives, clearly important to the decision to collaborate.

The behavioural theory of the firm is also important because it addresses the issue of firms operating under uncertainty and in an imperfect market in order to closely match firms' real situations (Cyert and March 1963). Cyert and March (1963) argue that firms exist to cope with the inherent complexity of the market where individuals would be limited in their ability to take rational decisions faced with great uncertainty. Hence the core focus of the theory is the decision making process within firms, as it is this that distinguishes firms from individuals with productive outputs. With regard to the decision-making process, the key concepts used in this theory are: Goals, expectations and choice (Cyert and March 1963; March 1988).

It is the normal internal state of organisations to have conflicting goals. As the coalition (firm or organisation) is made up of members with different goals, these conflicts need to be resolved to meet the organisations objectives (often through payment). Cyert and March (1963) describe uncertainties derived from the behaviour of the market, supplier deliveries, shareholder attitude, competitor behaviour and the future actions of governmental agencies among others. They state that organisations avoid uncertainty by concentrating on short-term strategies and where planning is described as avoiding predictions of uncertain events.

The behavioural theory of the firm does not attempt to explain the existence of firms, but does allow an understanding of the process through which firms go in order to perform an action, be it planning or strategy development. The key point is that firms react to problems through a complex decision-making process. It is due to the bounded rationality of individuals that this decision-making process is so important, and is a key assumption in the explanation of a firm's actions, especially in an environment of uncertainty.

2.2.6 Summary

While these theoretical explanations provide a well argued set of reasons for vertical scope within firms, they also provide an explanation for the degree to which firms gain advantage through specialising, and leaving 'non-competencies' to market transactions. Further work in this area has begun to explore the RBV contributions to thinking on relationships themselves whereby advantage could be gained through the nature of relationships and how they are managed (Dyer and Singh 1998). One stream of management research that has focussed on this issue is in the area of purchasing and supply management. The following section discusses definitions of relationships, models of supply chain relationships and the emergence of the collaborative relationship as a discrete subject of study.

2.3 Relationships: purchasing and supply chain management views

2.3.1 Definitions of relationships

This section provides a brief outline of key management definitions relationships. Oliver (1990: 241) provides a generic definition of interorganisational relationships as

> *"relatively enduring transactions, flows and linkages that occur among or between an organisation and one or more organisations in its environment".*

Some scholars have described relationships between firms as entities in themselves, for example Lamming (1993), describes them as a quasi-firm, while others describe relationships as a process with a specific outcome (Cousins 2002). A common type of interorganisational relationship often discussed in the management literature is that between buyer and sellers and is the focus of most purchasing and supply chain literature.

The examination of relationships including those that involve buyers and sellers (or suppliers) reveals that there are a range of relationship types. This warrants a more in-depth discussion of models that explain relationships in terms of the process involved and the range of relationship types.

2.3.2 *Supply Chain Relationship Models*

A specific model used to examine the nature of relationships in more depth is that of the Industrial Marketing and Purchasing (IMP) project group. The project was established to challenge the traditional views of examining industrial marketing and purchasing. In the development of the model, Hakasson (1982) described four groups of variables and the relationships between them. The first variable was a description of the parties themselves (Organization). The second the elements of the process of interaction. The third and fourth variables were the environment within which the interaction takes place and the atmosphere affecting, and affected by, the interaction. The relationships between these variables is shown in the following model (See figure 2-1).

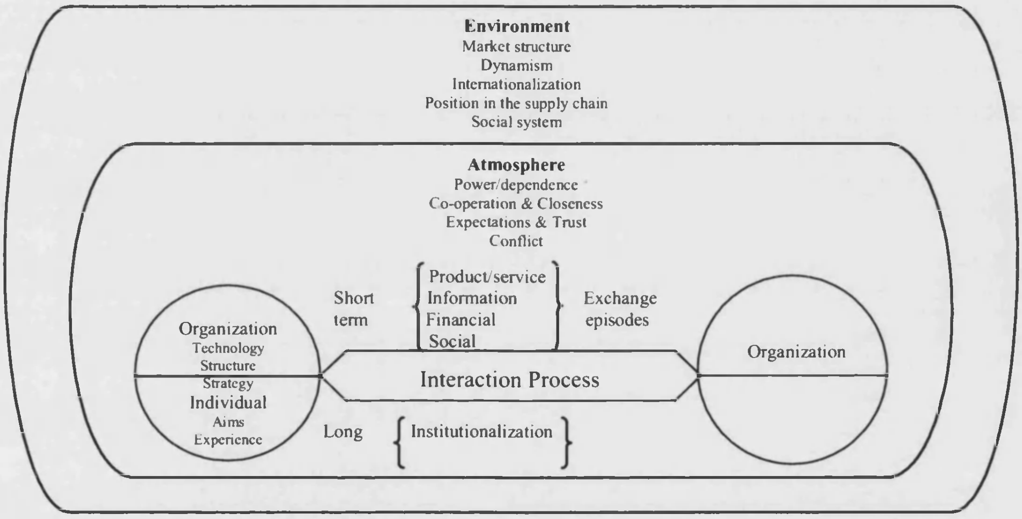

Figure 2-1 The IMP Group interaction model (Adapted from Ford 2002)

The project studied institutionalised roles, continuous supply and general dyadic relationships (a dyad comprises two parties), although the process can include more than two. The interacting parties are described in terms of organisational size, structure and strategy, their organisational experience and the individuals themselves involved in the interaction process. The actual process itself is further divided into episodes and relationships. Episodes are described as product service exchange, information exchange and social exchange (Hakansson 1982). Furthermore, relationships are described as institutionalised, contact patterns and adaptations (such as cost reductions). One of the key findings of this project is that as exchange/interaction practices become institutionalised, the costs (of the interaction) tend to reduce. This finding is consistent with the TCE view held by Chiles and McMackin (1996) who explain that governance cost tend to reduce with greater degrees of trust.

The actual interactions between firms should not be viewed as homogenous and that a variety of interactions may be possible. Building on the IMP research, Araujo et al (1999) suggest that there are four types of interfaces between customers and suppliers (from the customer perspective) which depend on how the supplier's resources are accessed by the customer. These interfaces are argued to be: standardised where products are as standard; specified where the customer provides a complete blueprint of the product needed; translation where the supplier interprets the needs of the customer and interactive where the design and manufacturing parameters are more open-ended. Araujo et al (1999) argue that each type of interface requires a different type of interaction ranging from little or no connections between the user and producer to joint development based on combined knowledge of product use and production. This analysis of the types of relationships that firms can undertake has been the subject of a great number of academic discussions particularly in the developing field of supply chain management.

One of the earlier models of supply management was developed by Kraljic (1983).

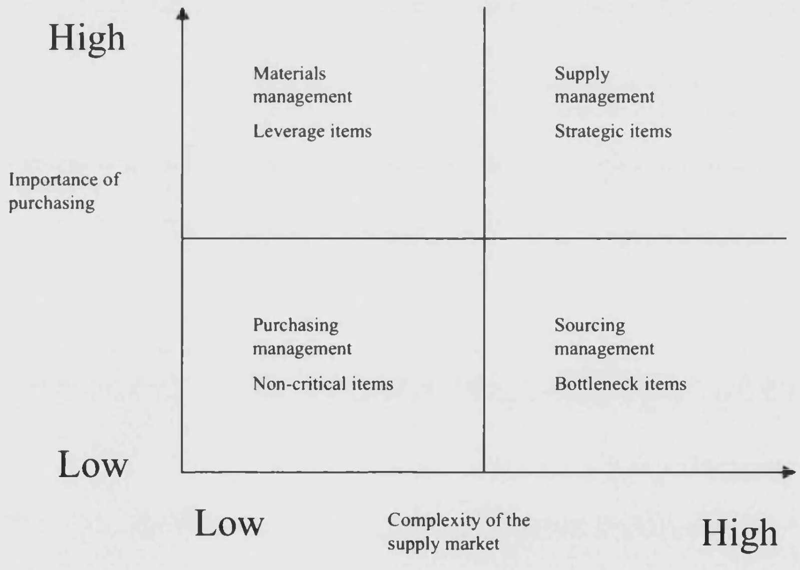

Figure 2-2 The Kraljic model of supply management

Although not a model of relationships per se, the Kraljic model has implications for how relationships may differ depending on the parameters described. The model essentially outlined the focus that managers should take on supply management by again classifying different types of relationship on the basis of the importance of purchasing and the complexity of the supply market. Kraljic (1983) argued that the importance of purchasing relates to the total costs or value of materials and the complexity of supply market included characteristics such as monopoly or oligopoly conditions, pace of technological advance and entry barriers. Where bought-in materials are of high value and subject to monopoly conditions (price fixing risks) and rapid technological change, a supply management approach should be taken. This contrasts with low value items that are freely available in relatively simple market conditions, in which a purely low level purchasing approach should be taken. While this model did provide an extensive explanation of how supply management should be focused, the role of the actual relationships between firms is not determined. Thus supply management literature developed further by employing antecedent economics perspectives such as TCE, exemplified by the work of Sako (1992).

Supply chain management literature has continued to offer descriptions of the types of relationships suggesting that they vary along a continuum from traditional, adversarial, intermediate, partnership to network relationships (Goffin et al. 2006; Spiers 1997). This builds on the work of Sako (1992) who classifies relationships along a range from arms-length (ACR) to obligational contractual relationships (OCR). Utilising Williamson's (1975) explanation discussed earlier, Sako describes arms-length relationships as characterised by non-specific assets, minimal information exchange, separable technological and functional systems, and thus, low transaction costs. The arms-length relationship is typified by a short-term view and the vehicle of 'open-tendering' (Lamming 1993). In this case it is simple for firms to change trading partners without adverse effects, due to other sellers offering very similar products. This efficiency in routine tasks is the strength of market-based relationships (Dyer and Singh 1998).

The distinction between ACR and OCR can also be explained using the Exit and Voice modes of supplier relationships (Helper 1987; Hirschman 1970) whereby Exit corresponds to ACR, where a suppliers contract will be terminated if it does not meet the agreed requirements, and OCR corresponds to 'Voice' where there is dialogue to resolve problems and termination is a last resort. Specifically exit is described as "*where the customer firm's response to problems with a supplier is to find a new supplier*".

Voice is described as "*where the customer's response is to work with the original supplier until the problem is corrected*" (Helper 1993: 142).

Helper (1993) distinguishes between 'exit' and 'voice' by placing them on an axis between the level of mutuality of information exchange and the level of commitment which was measured as contract length and the degree of trust. Sako (1992) distinguishes OCR from ACR by using the degree of interdependence (relating to goodwill and competence trust) and the time span for reciprocity which could be argued uses the same concepts as Exit/Voice. One of the key determinants of voice and OCR is the concept of trust and the degree to which it is present. A key definition of trust that is used is again developed by Sako and states that

> *"trust between trading partners has a role in increasing the predictability of mutual behaviour through the honouring of commitments made, while it facilitates dealing with unforeseen contingencies in a mutually acceptable manner" (Sako 1992: 37).*

Predictability in behaviour exists for different reasons and this allowed Sako (1992) to distinguish between three types of trust: Contractual trust – that the party promises will be kept; Competence trust – that the party will carry out the task technically and managerially competently and Goodwill trust – that the party is dependable and is given discretion.

Sako (1992) proposes that having trust in a relationship reduces the need for control and so transaction costs are reduced. Dyer and Chu (2003: 260) confirm this by stating that trust is an alternative to price, contracts and authority, providing a definition as follows *"one party's confidence that the other party in the exchange relationship will not exploit it's vulnerabilities"*. The point being that relationships based on transactions with trust are more likely to be market-based, because the risks of opportunism are reduced. Therefore transactions which would normally be integrated into firms are in fact left to the market, albeit within a hybrid form of governance.

In a further development of supply chain relationship models, Lamming (1993) suggests that assessing customer-vendor (supplier or seller) relations is an important way of understanding how they vary and proposes eight factors for this assessment. These are: the nature of competition in the market; the basis for sourcing decisions; the role of data and information – one-way, closed, open-book, cost transparency, EDI; attitude to capacity planning; delivery practices; attitude to price change – negotiation, collaborative; attitude to quality – inspections ; research and development – and a later included factor – the level of pressure

From this method of assessing relationships Lamming constructed a four-phase model of customer-supplier relationships. The phases move through traditional, stress, resolved and partnership, which Lamming (1993) proposes are phases that industry has seen in the past three decades. Taking these phases and relating them to the basis of sourcing decisions helps clarify the differences and is shown in table 2-2.

Table 2-2 Showing the phases of supply model development (Based on Lamming 1993)

Phase	Basis for sourcing decisions
Traditional	Wide, enquiries, lowest bid and price based
Stress	Dutch auctions, again price based
Resolved	Price, quality and delivery
Partnership	Performance history, long term source costs

Lamming takes this development of types of supply to a further point named 'lean supply', a concept developed in the book 'The Machine That Changed The World' (Womack et al. 1990). In fact much of the thinking on supply relationships, particularly in industrial sectors, has been based on examining the Japanese models of managing the supply chain. The Japanese industrial supply chain has traditionally been associated with the *keiretsu* system whereby powerful customers, usually large conglomerates, own stakes in their main suppliers, creating horizontally connected and vertically integrated groups of companies (Lamming 1993). These formal ties create an integrated ownership structure that is typified by efficient information exchange at the strategic level allowing the monitoring of operational and financial data (Womack et al 1990). Although this model is very specific to traditional Japan industrial structures, the examination of the *keiretsu* system and its implications for other contexts has contributed significantly to the debate on supply partnerships.

The partnership model has been criticised as relying on junior and senior partners and suggests that collaboration should be based on equal contributions from 'partners'(Lamming 1993). Thus the next phase would be based on *"early involvement of established suppliers in joint efforts in target costing/value analysis, single and dual sourcing, supplier provides global benefits and re-sourcing as a last resort after attempts to improve"(Lamming 1993: 194)*

The importance of early involvement of suppliers in business decisions such as the new product development (NPD) process is supported by Handfield and Ragatz (1999) who demonstrate that many firms view this as a vital part of the NPD process and improves project results compared with non-involvement of suppliers. Lamming's (1993) model is essentially a model of development of relationships in supply, and in order to provide an assessment tool for buyers the RAP model of Lamming, Cousins and Notman (1996) build on previous thinking on supplier relationships.

The RAP[5] model developed by Lamming, Cousins and Notman (1996) is a model of relationships between firms accounting for both buyer and supplier perspectives and the nature of the actual relationship. Specifically, the model considers supplier and customer dimensions of a relationship including the influencers such as competitive pressures, priorities and internal relationships, as well as the enablers such as resources and characteristics of the transaction (size, type and frequency). The characteristics of the relationship itself are also examined by considering the closeness, power issues, dependency, problem solving, benefits and depth. This is a practical tool for firms to assess the appropriateness of its relationships to the type of transaction and it is based on an empirically derived conceptual model. However, although processes within a relationship such as problem solving are assessed, the model does not view the relationship as a process itself, a view seen as incorrect by Cousins (2002) who argues that due to the large number of interfaces between a buyer and a supplier, a relationship as a single entity is not an accurate depiction.

Taking a process view leads to an exploration of goals and outcomes. Thus examining the 'value' of relationships begins to highlight that resources and routines, the sources of value according to the RBV, may be embedded between firms as well as within them (Jap 2001). The relational view taken by Dyer and Singh (1998) uses elements of the RBV and TCE to explain that competitive advantage can be gained from idiosyncratic interfirm linkages and the relationships on which they are based.

[5] Relationship Assessment Procedure

Dyer and Singh (1998) argue that ACR-types of relationship cannot generate relational rent (comparative advantage from interfirm linkages). This is because they are not idiosyncratic in the terms of RBV i.e. they are not rare or difficult to imitate and so cannot produce competitive advantage, unless buyers are comparatively more powerful within the bargaining process, so can reduce costs this way. Moving relationships away from traditional market-based forms however, does represent the opportunity for competitive advantage (Dyer and Singh 1998).

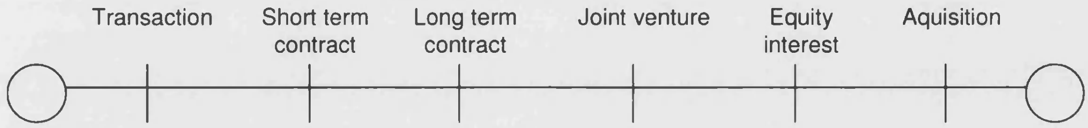

Figure 2-3 Types of relationship (Adapted from Harland 1996; Lambert et al. 1996)

Figure 2-3 provides a summary of the types of relationships that are possible along a continuum of integration of the function taking a TCE perspective from market to hierarchy. This continuum is consistent with the TCE view of the boundary of the firm being a decision variable, along which a number of forms exist between polar forms of pure market transactions through what Williamson (1991) called hybrid forms, to integration (or acquisition as shown on the right of figure 2-3). Although this view tends to focus on governance structures, relationships can be seen as *"both a governance structure for organizing exchange as well as a productive asset or resource"* (Madhok and Tallman 1998).

The literature suggests that by taking an RBV approach relationships themselves can provide comparative advantage especially when viewed as collaborative. The concept of collaboration (and its extent) appears to be a distinguishing factor of more cooperative, partnership-like forms such as those described by Lamming (1993) and Ellram and Hendrick (1995). The next section describes the concept of collaborative relationships more specifically.

2.3.3 Collaboration: Long term, close and partnership relationships

The discussion of collaborative relationships highlights a range of terms used to describe apparently similar phenomenon. Collaborative relationships have variously been termed as: cooperative (Dyer and Singh 1998; Johnston et al. 2004; Ring and Van de Ven 1992); close (Goffin et al. 2006) and partnership (Ellram and Hendrick 1995;

Lambert et al. 1996; Lamming 1993; Macbeth and Ferguson 1994; Mohr and Spekman 1994).

Mohr and Spekman describe these types of relationships as

> *"purposive strategic relationships between independent firms who share compatible goals, strive for mutual benefit, and acknowledge a high level of mutual interdependence. They join efforts to achieve goals that each firm, acting alone, could not attain easily" (1994: 135).*

In a less prescriptive sense, Ring and Van de Ven (1994: 90) make the distinction that they lie between "discrete market transactions" and "internal hierarchical arrangements". Cooperative relationships are typically formed through a process of negotiation, commitment and execution and the reasons for their formation can include cost minimisation, risk sharing and learning (Barringer and Harrison 2000; Ring and Van de Ven 1994).

A useful definition of collaboration later developed by Spekman, states that it is

> *"the process by which partners adopt a high level of purposeful cooperation to maintain a trading relationship over time".* He goes on to state that *"the relationship is bilateral; both parties have the power to shape its nature and future direction over time" (1998: 77).*

The concept of partnering as developed in the supply chain management literature is a term widely adopted by the business community. Ellram and Hendrick (1995: 41) provide a definition of partnering as an

> *"on-going relationship between two firms that involves a commitment over an extended time period, and mutual sharing of information and the risks and rewards of the relationship".*

More recently, collaboration has also been defined as a

> *"cooperative, interorganisational relationship that is negotiated in an ongoing communicative process, and which relies on neither market nor hierarchical mechanisms of control", that could include "consortium, alliances, joint ventures, roundtables, networks, associations" (Hardy et al. 2003: 323).*

However, this excludes other types of relationship that are based on a contractual agreement or some other type of legitimate authority such as a regulator (Hardy et al. 2003) which rules out the consideration of supplier-buyer relationships that may be more collaborative in nature. The motivations behind cooperative IOR include gaining new technologies, markets, scale economies, complementary skills and risk sharing (Powell 1990).

A number of other types of cooperative or collaborative relationships have also been described previously. These are variously described as trade associations, voluntary agency federation, joint programmes, corporate financial interlocks and agency-sponsor linkages consortia (Barringer and Harrison 2000; Oliver 1990), joint ventures (Harrigan 1985), strategic partnerships (Lorenzoni and Baden-Fuller 1995), alliances (Kanter 1990), networks (Alter and Hage 1993; Thorelli 1986), network alliances (Gomes-Casseres 1994). The main focus of these types of cooperation is how strategic performance can be improved by spreading risks, sharing resources, improving flexibility, accessing knowledge and gaining new market opportunities.

Oliver (1997: 707) succinctly describes the benefits of strategic alliances as allowing

> *"firms to procure assets, competencies, or capabilities that are not readily available in competitive factor markets, particularly specialized expertise (e.g. a joint venture to gain access to complex technological or product development capabilities) and intangible assets, such as reputation (e.g. a global alliance formed with a local host to enhance the firm's reputation in the local market)."*

There appear to be two sets of motives that drive the formation of strategic alliances. These are: to acquire technology-based capabilities from alliance partners and/or to gain access to other firm's capabilities to support a focus on the existing capabilities within each firm of the alliance, leading to greater specialisation in the individual firms (Mowery et al. 1996).

In addition to the buyer-supplier or vertical relationships described previously, there are also horizontal types of relationship between organisations with the same position in a value chain. Thus while collaboration has been discussed in the context of buyer-supplier relationships or the closer integration of production functions, collaborations can exist between firms in different contexts, for example linking with organisations non-economic goals

Other types of collaborative relationships include trade associations, joint programmes and consortia, and business-government collaborations have also existed in areas such as European economic policy making (Herrigel 1993). For example the function of trade associations can be summarised in the following list (Gault 1937): Distribution of information in relation to the trade members; Represent the industry before legislative and administrative bodies or public opinion; Technological research; Commercial arbitration; Conduct of employment bureaus, education and negotiation with labour; Cooperative sales promotion; Cooperative insurance; Operation of credit bureaus; Interchange of statistics; Education of members; Pooling of patents; Establish uniform trade rules, codes of ethics or practices.

Trade associations can also be thought of a information exchange mechanisms (Kirby 1988) as well as playing a political and economic role at both political and member (business) levels (Kelley 1990). Trade and professional associations tend to enable the sharing of norms, standards and rules of conduct between firms who normally compete, for example by producing product quality standards or ethical codes of conduct (DiMaggio and Powell 1983). However one of the issues relating to this type of exchange is that the resources obtained are equally available to all members and so competitive advantage between them is reduced, through greater homogeneity of the industry group (Oliver 1997). Again the emphasis here is on gaining resources which are valuable to the firm that cannot be obtained through traditional market (price) mechanisms. The main point made about these types of arrangements is that the barriers to obtaining valued resources are reduced[6].

Further reasons for collaboration have been developed by Contractor and Lorange (1988) and these include the following: risk reduction; economies of scale and / or rationalization; complementary technologies and patents; co-opting or blocking competition; over-coming government mandated investment or trade barriers; initial international expansion; vertical quasi-integration – this last point is specified as access to materials, technology, labour and capital, regulatory permits, access to distribution

[6] Further discussion of collaboration within environmental partnerships is made in Chapter 3 section 3.5.

channels, benefits from brand recognition, establishing links with major buyers and drawing on existing marketing establishment.

Bringing together definitions from the supply literature shows that collaborations between firms are neither purely market transactions, nor are they activities brought within the boundaries of the firm. The outcomes of these relationships go beyond what is contractually stipulated in written agreements, involving long times scales, bilateral communications, shared goals, shared risks, mutual benefits and a degree of interdependence.

This last point, risk sharing, is of particular note as TCE would state that the problem is essentially about adaptation whereby transaction-based contracts are costly to adapt due to uncertainties. These uncertainties arise due to the unpredictability of the future state of nature and also whether "the parties will be able to rely on trust as a counter to the problems of adverse selection and moral hazard" (Ring and Van de Ven 1994: 93), which relate to the TCE concept of opportunism.

Ring and Van de Ven (1994: 92) argue that what makes these types of relationships between organisations different from traditional market interactions are that they involve "tacit know-how assets" and "invisible assets". This begins to link the value of collaborative relationships to the RBV and show that *"relationships are not only a way to acquire resources, but also a way to develop resources"* (Hakansson and Snehota 1995: 182)

In an attempt to bring together the thinking on collaborative relationships Dyer and Singh (1998) state that the basis for competitive advantage from more collaborative relationships depends on four main characteristics of relationships. The first characteristic is investment in firm-specific assets, in particular if the contracts with a partner are long term and involve frequent exchanges. This ties in exactly with Williamson's (1975) assessment of when activities should be more integrated to the firm.

Dyer and Singh (1998) argue that the second characteristic relates to knowledge exchange between partners, although this partly depends on the incentives to encourage this exchange or transparency. An example would be informal reciprocity where one partner shares if the other does likewise. Absorptive capacity is also important where a firm will dedicate personnel to learn the characteristics of the partner. Ellram and

Hendrick (1995) claim that information exchange is a vital component of partnering relationships and that greater exchange between firms is expected in the future, between buyer and suppliers, to obtain the benefits of this approach to relationships.

Combining complementary resources is a third characteristic that relates to the *"distinctive resources of alliance partners that collectively generate greater rents than the sum of those obtained from the individual endowments of each partner"* (Dyer and Singh 1998). This characteristic builds on the RBV rationale for firm performance and presupposes that the firms involved can identify and evaluate the potential complementarities between their respective resources. For example Handfield and Ragatz (1999) suggest that buyers who want suppliers to be involved in the new product development process need to understand the engineering capabilities that suppliers have.

The final characteristic that Dyer and Singh link in originates from the TCE approach, that of transaction cost. They argue that more effective governance mechanisms can reduce these costs compared with competing alliances. The main types of governance mechanism are 3rd party enforcement agreements which rely strongly on legal contracts between firms, or self -enforcing agreements. It is this second type, that can be formal and informal, which are likely to produce relational rents as they are more idiosyncratic. The informal self-enforcing agreements rely on goodwill trust as described by Sako (1992) and the influence of reputation in minimising opportunism.

Jap (2001) tests these four factors of the relational view of competitive advantage and finds that the most important issues are coordination efforts and bilateral idiosyncratic investments. The fact that opportunism can be worsened in cases where asset specificity is high due to idiosyncratic investments, Jap (2001) argues that goal congruence[7] and trusting relationships between individuals can maintain advantages and overcome opportunism.

This issue of relational rents is also taken up by Madhok and Tallman (1998) in explaining the linkage between resources, transactions and rents. In their view the value of a collaboration is *"the ability of the partners to earn rents over and above what could have been achieved in the absence of the partnership i.e. in alternative organisational arrangements"* (Madhok and Tallman 1998: 3). An important concept to understanding the value of collaboration is that of quasi-rents. These arise when resources that are 'imperfectly mobile' can generate more rents in one firm when compared to other firms. These quasi-rents can be either firm-specific (which are the basis for RBV ideas of advantage through resources) or transaction-specific (central to TCE), both relating to asset specificity to firms or transactions. Madhok and Tallman state that the difference in firm specific resources can produce rents in a variety of product-markets, whereas transaction specific resources only provide rents to a particular transaction. A third form of quasi-rent is derived from collaboration-specific resources, whereby firm-specific and transaction specific resources are combined within a collaboration to provide rents over and above what the partner would achieve in the absence of collaboration (Madhok and Tallman 1998). Hence the benefits of a collaboration can result out of assets specific to the relationship.

An important aspect of the literature on collaboration is the impact of collaboration characteristics and success. In fact this area has been seen as lacking in the literature until recently. Determinants of partnership success[8] have been shown to be commitment, coordination and trust, the quality of information and participation in information use and transfer, and joint problem solving to resolve conflicts (Mohr and Spekman 1994). The most important determinants were shown to be trust, the coordination of activities and a sense of commitment.

This discussion leads to the implication that collaboration does not always have positive outcomes. As Cousins (2002) mentions, relationships of this kind always carry risks and uncertainty especially related to the behaviour of collaborating firms. While collaboration attempts to overcome issues of opportunism through frequent information exchanges, the risks are always present where partners are closely tied and dependent on each other. This issue has been comprehensively discussed by Williamson (1985) over the issue of managing relationships with high asset specificity and uncertainty, whereby the risks of opportunism should lead to integration within firms in order to evoke greater degrees of control. Jap (2001) also provides a stark warning of the risks of collaboration. Specifically there are dangers of foregoing alternative opportunities, possible inflexibility to technological changes, as well as the already mentioned problems of opportunism. On this point Jap (2001: 24) states

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[7] The mutual agreement of goals

"In an industrial supply setting, opportunism may involve misrepresentations e.g., making hollow promises or window-dressing one's efforts., unresponsiveness e.g., aloofness., unreasonable demands e.g., asking the other party to pay more than their fair share of a problem, and lying."

Spekman and Carraway (2006) also warn that intended information exchanges can also be danger whereby firms have to decide what is in bounds and what is not. The unintended sharing of sensitive data or tacit knowledge could potentially lead to the erosion of the firm's core expertise. Hence, while the positive aspects of collaboration have formed the core of much of the literature on the subject, there is a need to recognise the associated dangers of such practices.

The emphasis of much of the work on collaboration has been on actors in an exchange (using the terminology of the IMP group), or a buyer and a seller, or between two horizontally equivalent firms. However, this emphasis on what is known as a dyad (exchange between two parties) has been criticised as it does not accurately reflect the reality of inter-related relationships in a complex, multi-level hierarchy (Hakansson 1987). Leading from this realisation, the network view developed and is briefly discussed next.

2.3.4 Supply Networks

Networks within the purchasing and supply field have been described in a number of ways ranging from marketing (Hakansson 1987) through strategy (Jarillo 1988) to purchasing (Lamming 1993; Macbeth and Ferguson 1994). Networks are again offered as a third governance structure between markets and hierarchies (Miles and Snow 1984). One of the early definitions of networks is of

"more or less permanent structures which bind individuals together into complex lines of communication and transportation" (Moreno 1934: 214).

The network view can be stated as a conceptual or analytical tool which provides a complete view of the social environment encompassing relationships, a structure for a set of persons or structural description of a network based on the characteristics of relationships (Shulman 1976). Networks are described as being made up of actors,

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[8] Defined through measures of satisfaction and sales volume of the partners

resources and activities (Hakansson and Snehota 1995), which form the focus of research into the network conceptualisation of relationships. General types of networks include the following (Lamming et al. 2000): social networks such as industrial districts; Bureaucratic networks such as trade associations and consortia with exchange or associational contractual agreements and joint and/or capital ventures with equity and property rights. Supply networks are the focus of Lamming et al's (2000) work which describes a number of types based on the types of products being supplied. Supply networks are defined as "sets of supply chains, describing the flow of goods and services from original sources to end customers" (Lamming et al. 2000: 676).

From the perspective of relationships and firm performance, it is proposed that competitive advantage can be gained by strategically managing the network (Harland 1996). However the Scandinavian school of supply, in taking a resource dependency perspective, state that networks cannot be managed, only coped with (Hakansson and Snehota 1995). Harland (1996) describes a study of networks and provides a depiction of a network to give an example as follows in figure 2-4.

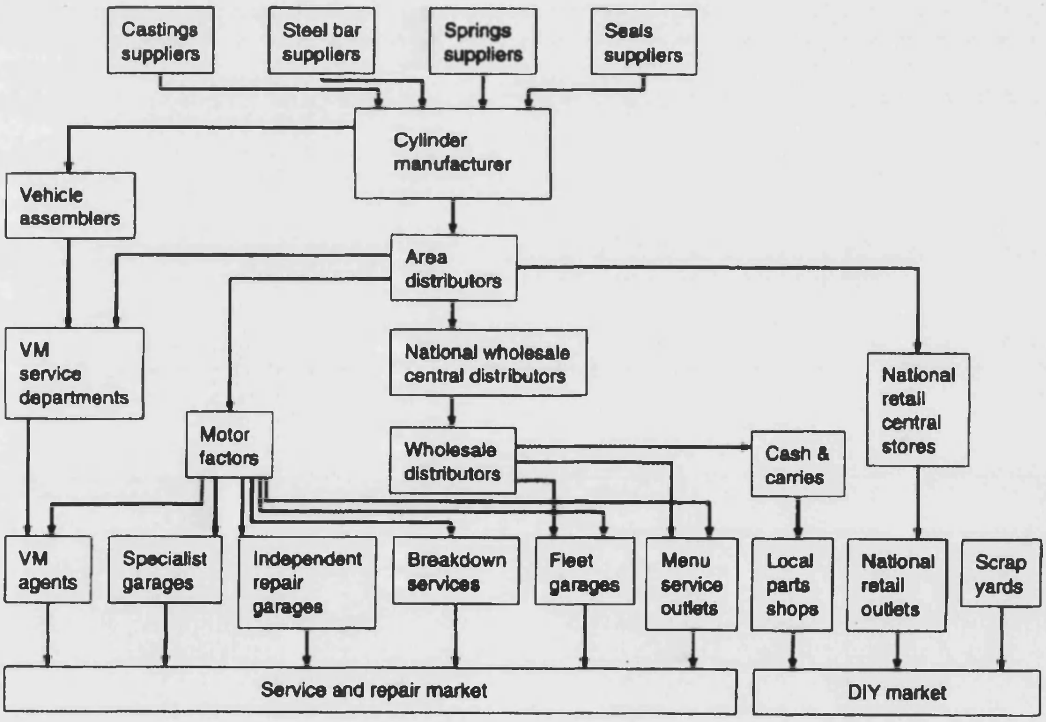

Figure 2-4 Example of a network (From Harland 1996: 75)

Another conceptualisation of a network is presented by Choi and Hong depicting a structure of a partial automotive supply network (shown in *Figure 5-5* p.123).

Two concepts in the literature stand out as being important to the study of networks, and these are density and centrality. These concepts are often used to describe resistance to institutional pressures in particular. Density is a characteristic of a complete network and is the result of the number of ties in the network and is measured by a ratio of the number of ties by the total number of possible ties if each actor were connected (Oliver 1991). As density increases the communication becomes more efficient. A point made by Rowley (1997) is that norms are diffused in a dense network more effectively, thus contributing to homogeneity of firms in a network, and drawing on the institutional view of firm actions (discussed in the next chapter).

The second concept, centrality, relates to the position of an individual or organisation in a network. Structurally this means the number of direct ties to others in the network (and/or independent access and/or control over other actors, depending on the type of centrality measured). Rowley proposes that *"as the focal organisation's centrality increases, its ability to resist stakeholder pressure increases"* (1997: 900). This is because the organisation is able to manage information flows by preventing or biasing communications across the network.

Although networks are a useful perspective to view the complex interactions between organisations, it often relies on established theories such as institutional or resource-dependence views, in order to make contributions from a normative or instrumental standpoint (Rowley 1997). Recent research into networks has revealed that firms may be in an enhanced competitive position because their network structures allow them to exploit their internal capabilities more effectively, whereby the innovativeness of network partners indirectly supports the focal firm's performance (Zaheer and Bell 2005). McEvily and Markus (2005) also find that the acquisition of capabilities is facilitated through network embedded ties and alliances and argue that while both trust and information sharing are important, joint problem solving is also key to transferring knowledge (especially when it is tacit, as described later in this chapter).

Since the research aims do not centre round resistance to institutional pressures this theoretical view will not be taken. However the network literature does provide useful techniques for understanding networks from a methodological perspective and so their contribution will be assessed in the methods chapter. Two concepts which have emerged from the review of collaboration from the network perspective and other relationship forms, are knowledge and innovation, and hence their contributions are discussed next.

2.4 Knowledge and collaboration

The 'relational view' described by Dyer and Singh (1998) purports that interfirm knowledge –sharing routines are an important source of interorganisational competitive advantage. They focus on the "transfer, recombination or creation of specialised knowledge" (Dyer and Singh 1998: 665). They go on to argue that sub processes that facilitate relational rents (competitive advantage) relate to the absorptive capacity of the partners (their ability to assimilate knowledge from their specific partner) and encourage transparency and discourage free-riding (taking advantage without reciprocating) through incentives. Clearly then, this view is dependent on the concept of knowledge and how it is shared across collaborating organisations. This will be discussed in more depth in the following section.

The main concepts important to understanding the role of knowledge in collaboration relate to the types of knowledge and the means by which knowledge is created. The most fundamental distinction is between tacit and explicit knowledge (Polanyi 1958).

Tacit knowledge is acquired by experience, learning by doing, observation and imitation or as Polanyi (1966) eloquently states "we know more than we can tell". By contrast, explicit knowledge is codified, so that it is easily communicated by a language (Hall and Andriani 2002). The codes of explicit knowledge include words, numbers and symbols. Hall and Adriani (2002) argue that the difference between these types is not by way of a dichotomy but more akin to a spectrum or continuum with types at either end and variants in between. Nonaka (1994: 15) makes the distinction between information and knowledge as "information is a flow of messages, while, knowledge is created and organised by the very flow of information".

Nonaka (1994: 17) goes on to state that at an interorganisational level, formal provisions can be made to build knowledge

> *"if informal communities of interaction, that span the link between customers, suppliers, distributors, and even competitors, are put on a more*

formal basis, for example, through the formation of alliances or outsourcing".

The second major conceptual distinction is about how knowledge is created. This centres round whether the knowledge is additive, complementary or substitutive (Hall and Andriani 2002). The ways of creating knowledge tend to depend on the assumption that knowledge is created through conversion between tacit and explicit. Nonaka provides a description of four modes of knowledge conversion as shown in figure 2-5.

from \ *to*	*Tacit knowledge*	*Explicit knowledge*
Tacit knowledge	Socialization	Externalization
Explicit knowledge	Internalization	Combination

Figure 2-5 Showing the knowledge creation process modes (Based on Nonaka 1994)

The ways of creating knowledge include socialisation such as 'on the job' training thus shared experience is vital for this form of creation to operate. Explicit to explicit knowledge creation named combination by Nonaka and can be facilitated through meetings and conversations, and even computer systems. Moving from tacit to explicit, or externalisation, and from explicit to tacit, internalisation demonstrate that the types are complementary and a process of mutual interaction occurs between them (Nonaka 1994).

The importance of these concepts to collaboration, and the benefits of collaboration, centre round the ideas that firms can learn from each other and depending on the type of knowledge, competitive advantage can be gained (Dyer and Singh 1998). Returning to the RBV is useful at this point. The definitions of resources align well with tacit knowledge, which can be thought of as a resource, having the key characteristics of being; tacit (causally ambiguous), socially complex and rare (firm specific) (Teece 1987; Winter 1987) or could be described as 'invisible' assets (Itami 1987).

An example of the importance of learning across firm boundaries is the case of Toyota and their suppliers. Here Dyer and Nobeoka (2000) state that knowledge is transferred by Toyota to their suppliers by allowing engineers to bring in their expertise. This example of socialisation - tacit to tacit knowledge - has allowed the suppliers and OEM to achieve above normal returns and gain competitive advantage.

Kogut and Zander (1992: 77) explain the links between knowledge and cooperation by stating *'know-how is the knowledge of how capabilities of individual firms might be harnessed through cooperation".* This particularly relates to the ability to identify who it is that holds the necessary knowledge – for example in a network of firms – and how to obtain it.

From the perspective of managing knowledge–sharing between firms, the idea of reciprocity is crucial. Again taking the Toyota example suppliers are required to reciprocate the transfer of knowledge from Toyota engineers by opening up their plants to other supplier network members and while they can keep 100% of any savings gained, they are expected to reduce prices when necessary (Dyer and Nobeoka 2000).

Kogut and Zander (1992) make the point that one explanation of the firm is actually that they exist because they share and transfer knowledge of individuals and groups better than markets. Simply 'buying in' knowledge in the form of employees is not a sufficient explanation as knowledge is embedded in the organising principles of cooperation in organisations.

In an examination of strategic alliances Mowery et al (1996) show for effective knowledge transfer to occur absorptive capacity aids its promotion, especially where absorptive capacity involves experience in related technology areas. The type of alliance also creates variation in the degree of knowledge transfer. Equity arrangements were also shown to promote knowledge transfer more effectively than purely contract-based alliances although the mechanisms for these differences were not shown by Mowery et al (1996).

Although the focus of this research is not the creation, transfer and assimilation of knowledge, the sharing of knowledge has been identified as an important aspect of collaboration and the benefits of collaboration (Dyer and Singh 1998). Routines (as described by Dyer and Singh) are an insightful characterisation of knowledge, and although proposed to be incomplete (Kogut and Zander 1992), they are of relevance to the benefits of collaboration and the RBV explanation.

2.5 Innovation and collaboration

Leading from knowledge and its role in collaboration highlights innovation. Hence, examining the literature on collaboration in all its forms, there is unquestionably a role for collaboration in the innovation process itself (Dodgson and Rothwell 1994). Building on this link between knowledge and innovation, especially where the innovation needs to be protected either through 'trade secrets' or patents, Teece (1988) argues that if information about an innovation is codified, it is relatively easy to transmit and receive information about it. However if it relies on tacit knowledge, then the transfer of knowledge about innovation is far more difficult (Teece 1988). This has ramifications for sharing technological product or process knowledge between collaborating firms.

Collaboration, from a technological point of view (like for other reasons) can occur horizontally or vertically. Vertical forms of collaboration between suppliers and customers can be vital to the innovation process, but horizontal collaboration between competitors can be problematic in that disputes over ownership can occur (Dodgson 1994).

Problems relating to vertical collaboration and the innovation process can stem from suppliers being required to reduce costs in the short-term and not being able to provide innovation in the long run leading to a zero-sum game (Sako 1994). Sako argues that there is risk involved in outsourcing, but using a partnership approach or strategic alliance with an innovative supplier can retain innovative capability. However to maintain such capabilities requires mutual trust, learning capacity and incentives for contributing to innovation (Sako 1994).

Chesbrough and Teece (2002) offer an alternative argument with regard to outsourcing especially in the area of innovations. They argue that many firms which have not invested in manufacturing, management and distribution or have outsourced them, have not been able to realise the gains from their innovations. The authors go on to state that strategic leverage and coordination is vital to obtain gains from innovations especially when they are systemic hence the integration of these activities can be important. Systemic innovations are particular in that

> *"their benefits can be realised only in conjunction with related, complementary innovations" and go on to describe that for instant photography "Polaroid needed to develop both new film technology and new camera technology" and that "lean manufacturing is a systemic innovation because it requires interrelated changes in product design, supplier management, information technology" (Chesbrough and Teece 2002: 128).*

From an innovation perspective Dodgson (1994) argues that modes of collaboration are underpinned by three basic assumptions. The first assumption is that there are mutual benefits based on; increased scale and scope of activities, shared costs and risk, and improved ability to deal with complexity – of forms and sources of technology. The second assumption is that environmental uncertainty is linked to collaboration as a means to manage and control its effects. Abernathy and Utterback (1975) show that collaboration often occurs early on in the stages of a products life cycle when there is uncertainty, extensive collaboration occurs until a 'dominant' product design becomes the norm. The third assumption discussed by Dodgson (1994) relates to flexibility and efficiency, avoiding costly investment and assets for innovation, whilst maintaining a route to tacit knowledge which may not be available through normal market mechanisms (avoiding the pricing of technological knowledge) linking back to Kogut and Zander's (1992) arguments.

The importance of knowledge transfer and creation (for innovation motives as well as other activities) and the ability of firms to do this effectively is one explanation for the existence of firms. However the origin of this knowledge and the limits set on what firms can do with this knowledge is dependent on the external influences on firms from other organisations.

2.6 Conclusion

Returning to the original questions set out in the introduction to this chapter provides the summary and conclusion for this chapter. What is collaboration, why does it exist and what are the implications are the questions that have been addressed in this chapter. The bases for collaboration between firms are interorganisational relationships. The definitions of IOR include terms such as enduring transactions that are formed through negotiation, commitment and execution and governance forms that exist between markets and hierarchies. There is a process of interaction between parties in a relationship that is influenced by the broader environment within which the relationship exists. For the purpose of this research the focus is on relationships between buyer and suppliers (of products and/or services).

Transaction or exchange relationships can vary along a continuum which extend from purely market based (relying on open tendering processes) to more collaborative types typically expressed as obligational contractual relationships, 'voice', cooperative, close and partnership, where parties will work together to resolve problems between them. The distinguishing features of more collaborative relationships are the degree of information exchange, commitment, length of agreements and importantly trust. Although, trust takes a number of forms, goodwill trust is often the most associated with collaboration. Modes of supply relationships are proposed to have developed over time from traditional written contracts based such as arms-length contractual arrangements to the 'lean supply' model characterised by joint efforts and 're-sourcing as a last resort' approaches such as obligational contractual relationships. However, much current research has focused on close or partnership-type relationships.

Collaboration comprises of purposeful cooperation, with bilateral influences, with governance structures which appear to sit between markets and hierarchies. Collaboration can also take a number of different forms from vertical supply to horizontal joint ventures, alliances, research consortia and trade associations. Network theory suggests that complex arrangements within networks also exist that may exert pressure on firms to conform or may be manipulated to advantage depending on the firm's position.

The reasons for collaboration, relate closely to its defining features. The first major explanation for why collaboration happens relates back to the TCE view that opportunism should be minimised through mechanisms of control. Where there are assets specific to transactions, standard contracts are not sufficient, thus alternatives are needed. A second rationale is that valuable resources – the resource based view - may be needed to meet organisations objectives which cannot be procured through standard 'factor markets' again requiring an alternative method of acquisition. Overall, reasons have ranged from risk reduction, economies of scale, complementary resource use, to over-coming barriers to trade.

Research has indicated that firms can obtain advantage specifically from collaborative relationships over and above what is possible by individual firms. However gaining advantage is dependent on the specificity of assets to a transaction, whether knowledge-sharing is present, the combining of complementary resources and the type of governance mechanism. Given the right combination of these factors, firms are able to obtain a comparatively better level of rents (competitive advantage) than if working independently. This leads to the issues of knowledge-sharing and the nature of knowledge.

From a resource-based view it is often knowledge that is of value, because it cannot be acquired through normal market mechanisms, due to its tacit nature. Creating new knowledge through collaboration can lead to systemic innovations which are highly dependent on the collaborating parties providing the innovation in an integrated fashion. However a cautionary note is sounded here. There may be instances where activities should be integrated into firms and not outsourced due to the risk of losing essential competencies, such as manufacturing. The implications of collaboration are manifold from positive increases in rent producing ability to the erosion of competencies.

Overall, collaboration in its many forms can be of benefit for a variety of reasons. The diversity of ways of understanding and researching collaboration calls for a careful selection of definitions and set of research questions. Furthermore the implications of collaboration for the response to environmental pressure is tied to all these explanations and each one has a contribution to make to this understanding. To date much research into collaborative relationships has focused on manufacturer-supplier relationships (Chen et al. 2004; Dyer and Singh 1998; Ellram and Hendrick 1995; Goffin et al. 2006; Jap 2001; Johnston et al. 2004; Lamming 1993). Yet little research to date has looked at collaborative relationships between manufacturers and other service providers, especially in the area of product recovery and recycling specialists. The following chapter provides an outline of the definitions of product stewardship, and some of the key research themes within this area including why firms are involved and the effect on competitive advantage

Chapter 3 Strategies for Product Stewardship

3.1 Introduction

This chapter discusses the contributions that management literature makes to the concept of product stewardship. The aim of product stewardship is to "minimise a product's harmful effects on the environment at every stage of its useful life from concept, design, manufacturing, distribution, usage and disposal" (Dutton 1998: 59). This is a broad definition that encompasses most of the activities that a firm undertakes when producing products.

The management literature covers a number of current arguments tackling the debate on the 'role of firms in the natural environment' by discussing the concept of product stewardship. This debate posits a number of important questions, the first of which is why are firms involved in product stewardship? The literature provides an explanation based on a combination of external and internal pressures on firms. Second, if firms do engage in product stewardship are there benefits of doing so? Management scholars maintain that firms can gain legitimacy and competitive advantage if they undertake product stewardship, however empirical support for this is limited. A third strand of the debate discusses whether there are firm-specific resources and capabilities for product stewardship. These resources and capabilities may provide firms with an advantage to gain benefits from product stewardship. The chapter ends with the identification of gaps in current knowledge about product stewardship.

The following table (Table 3-1) provides an outline of the main literature sources used in this chapter. These sources provide the conceptual background and empirical evidence supporting product stewardship arguments. Distinct sets of literature cover concepts such as product stewardship, reverse logistics and product recovery, a further set discusses the role of external and internal factors in motivating firms to implement product stewardship activities. A third group of scholars have argued for the role of resources and capabilities in the explanation of why firms differ in their organisational and environmental performance related to product stewardship.

Table 3-1 Contributors to product stewardship literature

Concept	Sources	Definition of concept & Contributions
Antecedent theory to product stewardship	Lawrence and Lorsch (1967)	External environment and the firm
	Pfeffer and Salancik (1978)	Resource dependency: firms rely on the external business environment
	Suchman (1995) and DiMaggio and Powell (1991)	Institutional theory: firms seek legitimacy, respond to social norms and are constrained by norms
	Freeman (1984); Post et al (2002)	Stakeholder theory: firms should consider a broad set of individuals and groups
	(Freeman 1984) (Clarkson 1994) (Donaldson and Preston 1995) (Mitchell et al. 1997)	Definition of stakeholders Stakeholders as risk bearers Stakeholder theory Stakeholder identifications and salience
Product stewardship **LCA** **Product recycling and reverse logistics (RL)**	(Dutton 1998 p.59)	Definition of product stewardship
	(den Hond and Groenewegen 1993; Groenewegen and den Hond 1993; Handfield et al. 1997; Knemeyer et al. 2002; Kopicki et al. 1993; Roy and Whelan 1992; Toffel 2003; Whiston 1995)	Descriptions of product recycling activities in the automotive and electronics industries including take-back, collection schemes and modes of organisation
	(Stock 1998)	Definition of RL
	(Rogers and Tibben-Lemke 2001)	General review of RL
	(Carter and Ellram 1998)	Framework of drivers and constraints to RL
	(Dowlatshahi 2000)	A theory of RL
	(Meade and Sarkis 2002)	Decision model for selecting 3rd party RL providers
Drivers for product stewardship	(Fischer and Schot 1993; Welford 1995)	Defined as green issues which influence or are influenced by the activities of the business community.
	(Carroll 1979)	CSR defined 'four classes' of social expectations of organisations - economic, legal, ethical, discretionary
	(P Bansal and Roth 2000)	Firms go 'green' because of legitimacy, competitiveness and responsibility pressures
Legitimacy	(Fischer and Schot 1993)	Firms as 'resistant adaptation' driven by legislation. Firms become less defensive to compliance
	(Clarkson 1994; Cornell and Shapiro 1987; Freeman and Evan 1990; Madsen and Ulhoi 2001)	Stakeholders influence firms and firms react for legitimacy motives. Different stakeholders have different types and amount of influence

Ecological competitiveness	(Porter 1991) (Reinhardt 1999; Russo and Fouts 1997) (Hart and Ahuja 1996; Porter and van der Linde 1995; Shrivastava 1995a) (Walley and Whitehead 1994)	Green actions are driven by the need to reduce costs and increase revenue Responding can lead to higher revenue Responding can reduce costs Responding is nearly always a cost overall
Ecological responsibility	(Carroll 1979) (Key and Popkin 1998; Stead and Stead 1992; Wood 1991)	Ethical and discretionary expectations on firms Ethical considerations of executives, managers and firm employees motivate firms to act on ecological pressures
Type of ecological response	(De Burgos Jimenez and Cespedes Lorente 2001; Fischer and Schot 1993) (Handfield et al. 2005; Klassen and Whybark 1999; Prakash 2001; Shrivastava 1995a; Vastag et al. 1996; Welford 1995) (Muller and Koechlin 1992; Reinhardt 1999) (Bowen et al. 2001b; Gavaghan et al. 1998; Green et al. 1996; Lamming et al. 1996) (Hart 1995)	Strategy - strategic policy development Environmental strategy Environmental policy Initiatives - specific activities implemented Environmental technology • Environmental responses can be site-based • Product-based • Purchasing & supply chain - based Impacts - actual environmental impacts produced The type of response and ability to gain advantage depends on the resources the firm has
Ecological responses	(Carroll 1979; Fischer and Schot 1993; Prakash 2000) (Aragon-Correa 1998; Frosch and Gallopoulos 1989; Greeno 1991; Hunt and Auster 1990; Newman and Breeden 1992; Walley and Whitehead 1994) (Klassen and McLaughlin 1996)	The degree to which a response is compliant, proactive or gives an economic gain Environmental responses can vary from being non-compliant, compliant or over-compliant Responses can range from defensive to proactive Proactive strategies associated with better financial performance
Environmental capabilities	Hart 1995 Hart and Ahuja 1996 Sharma and Vredenburg 1998 Bowen et al 2001 (Aragon-Correa and Sharma 2003)	Defines capabilities needed link between emission reduction and firm performance Proactive responses are linked to specific capabilities Resources for proactive responses that lead to competitive advantage are contingent upon other factors

3.2 Theoretical background to product stewardship

Management theory that discusses the firm's approach to product stewardship often draws on theory that accounts for the interaction between the external environment and the firm. This thinking is tied to a number of views including the external control of organisations (Lawrence and Lorsch 1967; Pfeffer and Salancik 1978, 1997), institutional theory (DiMaggio and Powell 1991; Oliver 1991) and stakeholder theory (Freeman 1984; Post et al. 2002). Subsequently, recent authors have used these views to provide theoretical explanation for why and how firms adopt elements of product stewardship (Bansal and Clelland 2004; P Bansal 2005; Madsen and Ulhoi 2001; Prakash 1999; Sharma and Henriques 2005). Hence this section discusses these perspectives as a foundation for further discussions that are specific to product stewardship.

3.2.1 External Environment and the firm

Lawrence and Lorsch (1967) argue that firms perceive and interpret their external environment (not as a uniform and objective entity) and it is this process of perception and interpretation that determines how external pressures are acted upon. The main contribution of this perspective is that competitive advantage is thought to depend on the matching of internal capabilities with changing external circumstances, hence if an organisation's internal states and processes are consistent with external demands it will be effective in dealing with its environment (Lawrence and Lorsch 1967). While this links to the resource based view, it is the complex process of matching the external environment and the ramifications for the internal structures of firms that is of interest. This view has formed the basis for further theory development especially in relation to how firms are dependent on the external business environment.

3.2.2 Resource-dependency theory

Linking back to the external control of organisations, resource-dependency theory postulates that firms require external resources to survive and that firms interact with others that control these resources while trying to maintain their autonomy and discretion (Pfeffer and Salancik 1978). The 'others' referred to by Pfeffer and Salancik (1978) are defined in the broadest sense such as other firms controlling natural resources or providing services needed by firms to comply with legislation. These 'others' or social actors therefore influence the focal organisation through the control of critical resources. Hence, firms must account for these social actors in any actions taken which involve externally controlled resources.

In this case, firms need to understand who controls the resources they need and then are obliged to manage this relationship to their advantage. In order to know who controls resources, firms scan the environment external to them. This process is reported to be problematic as firms may scan their environment, assimilate information and then have to act on it i.e. must have a response. At this point there is a risk of over-responding as a result of how the firm registers information and how the firm acts on this information (Pfeffer and Salancik 1997).

Additionally, a point made by Pfeffer and Salancik (1978) is that environments are not seen as objective realities i.e. they are constructed through an enactment process. This process is derived from stages of perceptions, attentions and interpretations. These stages depend on the structure of the organisation, information systems and the distance of power and control within the firm, yet firms often only look inwards to find solutions to problems. This theory has been a precursor to other management thinking and few recent studies have adopted this view especially in the area of operations and supply management, with Handfield (1993) being one of the few exceptions.

3.2.3 Institutional theory

Institutional theory developed the argument that it is not only markets and governments that affect economic systems (firms), but other institutions as well (Oliver 1997). Thus firms also act in response to key external institutions in order to gain legitimacy. The early treatment of institutional theory did not recognise the importance of managerial autonomy, and further revisions developed the concepts of firms as seekers of legitimacy but incorporating the influence of individual managers within neo-institutionalism (DiMaggio and Powell 1991; Selznick 1996).

This perspective finds its roots in the observation that firms often show remarkable similarities that cannot be explained by industry type alone. Institutional theorists are able to show that the pressure to conform (to social norms) can result in inexplicable and inefficient organisational actions and structures, countering the efficiency arguments of traditional economic thought. Pressure to conform to these norms include coercive pressures (such as legislation), normative pressures such as professionalisation and mimetic pressures to reduce uncertainty. As a basis for institutional theory, institutions are sets of rules accepted by broader society, which then take on a structure within organisations that determine the way firms should function (DiMaggio and Powell 1983; Zucker 1988).

Strategic responses are proposed to have links with these institutional processes. For example, motivational resistance to external pressures can be explained by way of institutional process factors such as the consistency of institutional norms with organisational goals or the amount of social legitimacy attained from a response (Pfeffer and Salancik 1978). Importantly, a major issue is that 'isomorphism' - where organisations show similar characteristics, a key concept in neo-institutional theory – can be in conflict with competitive advantage gained from resources which are said to be idiosyncratic, in the resource-based view, (Barney 1991; Osborn and Hagedoorn 1997). While this explains why many firms are similar, especially in terms of structure, it also explains why advantage could be eroded through coercive, normative and mimetic pressures to conform to a single type (DiMaggio and Powell 1991). Furthermore, organisations (firms) respond in differing ways to pressures from the business environment, which can range from compliance to defying or manipulating behaviours (Oliver 1991).

Tolbert and Zucker (1996) argue that institutional theory is limited in explanation due to the lack of definitive boundaries. Problems also arise from this theory which centre on the difficulty in explaining why particular types of governance structure exist such as alliances, especially if efficiency arguments are ignored (Barringer and Harrison 2000). In fact Martinez and Dacin (1999: 80) propose that the efficiency motivation that is so important to TCE explanations is not fully accounted for and argue for an integration of TCE and institutional perspectives stating that "efficiency is not always the overriding imperative guiding organisational and individual decisions". Martinez and Dacin (1999) continue that some transactions involve 'socially constructed' transaction costs such as those associated with innovation (tacit costs) and confirm that firms carry out decisions based on imitation due to uncertainty about outcomes.

Institutional theory (especially neo-institutionalist views) plays a large part in understanding why and how firms undertake product stewardship and a number of recent authors have used this perspective (Bansal and Clelland 2004; Jennings and Zanderbergen 1995; Prakash 1999). A further linked set of literature deals with the mechanisms and actors involved in gaining legitimacy that has come to be known as stakeholder management and this is discussed next.

3.2.4 Stakeholder Management

In order to understand the broader role of the environment that surrounds firms, an important concept widely used in the management literature is that of stakeholders, and how and why they shape what organisations (firms) do. While firms seek approval and justification from broader society, another perspective considering a broader set of external interests by the firm, developed by Freeman, follows that

> *"given the turbulence that organisations are currently facing and the very nature of the external environment, as consisting of economic and socio-political forces, there is a need for conceptual schemata which analyse these forces in an integrative fashion" (1984: 40).*

Stakeholder theory is enlightening in reference to the external environment which by definition involves interorganisational relationships (as well as internal actors). Freeman provided one of the first definitions of stakeholder as

> *"a stakeholder in an organisation is (by definition) any group or individual who can affect or is affected by the achievement of the organisation objectives" (Freeman 1984: 40).*

This definition could be criticised in that a group could be affected even if the organisation does not achieve it objectives, and is so broad that it could encompass any individual or group. Therefore a number of more specific definitions have been made.

For example *"Voluntary stakeholders bear some form of risk as a result of having invested some form of capital, human or financial, something of value, in a firm. Involuntary stakeholders are placed at risk as a result of a firm's activities. But without the element of risk there is no stake" (Clarkson 1994: 237).*

Some writers have proposed stakeholders as contractors or participants in exchange relationships (Cornell and Shapiro 1987; Freeman and Evan 1990; Hill and Jones 1992). Other have viewed stakeholders as groups having a relationship with an organisation (Thomson et al. 1991). A recent definition is developed by Post et al

> *"The stakeholders in a firm are individuals and constituencies that contribute, either voluntarily or involuntarily, to its wealth-creating capacity and activities, and who are therefore its potential beneficiaries and/or risk bearers"(2002: 8).*

A depiction of a firm's stakeholders is shown in Figure 3-1, but interestingly it does not include competitors (apart from implicit in the joint venture partner description).

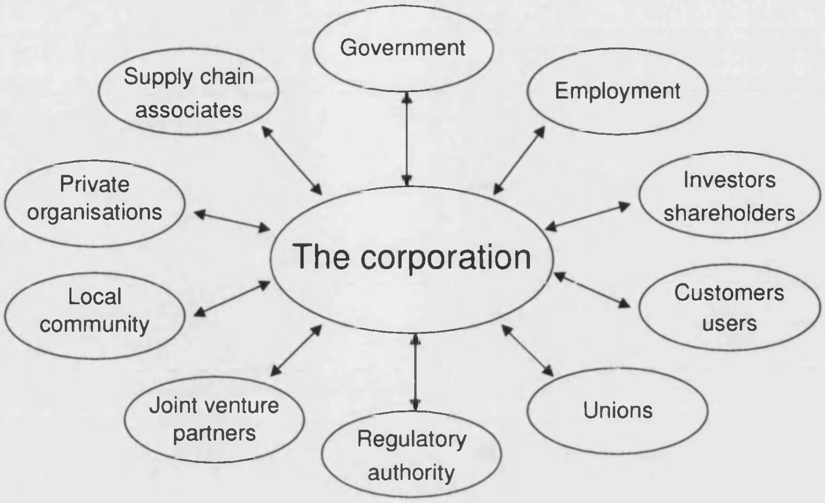

Figure 3-1 A firm's potential stakeholders based on Post et al 2002.

Success is determined by a firm's relationships with critical stakeholders, where stakeholder management is

"the development and implementation of organisational policies and practices that take into account the goals and concerns of all relevant stakeholders"(Post et al. 2002: 9).

From these perspectives especially relating to risk, customers have a stake in suppliers and suppliers in customers. Another key point is that stakeholder relationships are relational and not merely transactional (Post et al. 2002). However despite the apparent relevance of stakeholder theory to the study of firms and their external environment Donaldson and Preston (1995: 66) warn that this theory is problematic in that the conceptual bases are formed from diverse and contradictory evidence confusing concepts such as: stakeholder; stakeholder model; stakeholder theory and stakeholder management. Stakeholder theory can be thought of as descriptive, instrumental and normative. The instrumental, or predictive, qualities of the theory will allow the testing of links between a firm's stakeholder characteristics and the firm's outcomes or performance.

A central argument in stakeholder theory follows that adhering to stakeholder principles leads to (or is suggested to lead to) improved corporate performance – across a number of definitions of performance (Aupperle et al. 1985; Cornell and Shapiro 1987), but as Aupperle et al (1985) found, this link is difficult to demonstrate (and was not confirmed in their study). Additionally the actual logic of how stakeholder management leads to improved performance has been lacking in much of the research in this area. One particular problem is that measures have been confused between stakeholder management and corporate social responsibility measures[9] (Donaldson and Preston 1995). In an attempt to fill this gap in explanatory theory Freeman and Evan (1990) developed the theory by including the concept of contracts. In their view the firm is a set of multi-lateral contracts over time, which harks back to the Coasian and TCE perspectives. Reve (1990), as mentioned before, takes the view of firms as a nexus of internal and external contracts, bringing together the TCE and RBV viewpoints, and although Reve does not refer to stakeholders, external contracts are viewed in the context of strategic alliances.

In summary it could be argued that previous stakeholder theory has not been able to show a link between stakeholder management and performance and has been dominated by the normative contribution by emphasising the moral obligations of firms. An important contribution to the stakeholder theory development was the difference between explicit and implicit contracts (Cornell and Shapiro 1987). In describing this difference, it is shown that a firm has both explicit contracts (labour agreements, supplier contracts) and implicit contracts (such as the promise to continue service to customers and job security to employees), but these have little legal standing. Cornell and Shapiro define implicit contracts as

> *"too nebulous and state contingent to reduce to writing at a reasonable cost"(1987: 6).*

This appears to relate back to the TCE rationale of the high cost to write complex contracts. Cornell and Shapiro argue that if implicit claims are considered, then stakeholders will play a role in financial policy and therefore performance. In explaining the role of this contract explanation Freeman and Evan draw on the TCE view of firms that

> *"managers administer contracts among employees owners, suppliers, customers, and the community. Since each of these groups can invest in asset specific transactions which affect the other groups, methods of conflict resolution, or safeguards must be found" (Freeman and Evan 1990: 352).*

[9] Corporate Social Responsibility is discussed in the next section

Taking this argument, 'integrating stakeholders' is one way to reduce the risk of opportunism without writing costly explicit contracts, especially when they have invested in specific assets (expertise, people, sites, plant).

In an attempt to explain the benefits of understanding stakeholder management Post et al (2002) point out that

> *"knowledge about non-market stakeholders helps the firm to build constructive social and political relationships, anticipate and minimise the impact of unfavourable developments, and preserve it's 'license to operate' in the face of changing circumstances"* (Post et al. 2002: 25).

From a product stewardship point of view where operating licences can be revoked or heavy penalties can affect profits, stakeholder theory is relevant description of relationships.

The questions, who are the firm's stakeholders and which ones do managers pay attention to, are the basis for a theoretical perspective that attempts to explain the identification of stakeholders and their salience (importance) to firms. In order to provide a theoretical basis for answering these questions, Mitchell, Agle and Wood (1997) explain that power, legitimacy and urgency are key traits of stakeholders that should be considered in evaluating their salience. Power is described as "the probability that one actor within a social relationship would be in a position to carry out his own will despite resistance" (Weber 1947) or the "ability of those that possess power to bring about the outcomes they desire" (Pfeffer 1981)[10]. Legitimacy, which underpins the normative view of stakeholder thinking, is defined as

> *"a generalized perception or assumption that actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, value, beliefs and definitions"* (Suchman 1995: 574).

Urgency is used to move the theory from a static model to a dynamic one considering time issues. Thus urgency is "the degree to which stakeholder claims call for immediate attention" (Mitchell et al. 1997: 867). Mitchell, Agle and Wood go on to argue that CSR has two divisions - that there is a moral focus on social responsibility - and secondly

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[10] Power has been described as coercive (based on physical force etc), utilitarian (based on material or financial resource) and normative (based on symbolic resources such as prestige, esteem) A Etzioni, *Modern Organizations* (Englewood Cliffs, NJ: Prentice-Hall, 1964).

that there is an amoral focus on social responsiveness. They propose that their theoretical perspective integrates these two views by considering power, legitimacy and urgency traits of stakeholders.

Referring back to previous discussions of collaboration specifically the network perspective, Rowley argues that a network of stakeholders influence firms through simultaneous demands and that the network constructs of density and centrality impact on how these demands are dealt with. He also argues that the stakeholder perspective is useful in explaining the origins of external pressure from both institutional and resource dependence viewpoints (Rowley 1997).

Stakeholders are said to have varying influences from an ecological perspective depending on the type of stakeholder, varying from indirect to direct influences. For example in their study, Madsen and Ulhoi (2001) demonstrate that whilst legislators and regulators are seen as having a direct influence on firms, others such as the media are more indirect influencers. Taking this idea further, research by Henriques and Sadorsky (1999) show a link between stakeholder types and levels of environmental response. While more proactive firms perceive all environmental stakeholders as important with the exception of the media, less proactive firms only feel the media are important stakeholders. More recent work has linked proactive strategies with deeper stakeholder relationships, and importantly environmental leadership not linked to regulatory stakeholders (Buysse and Verbeke 2003). Stakeholders have been shown to have coercive and normative influences, yet responses tend to be determined by internal issues such as track record and organisational structure (Delmas and Toffel 2004). Christmann (2004) highlights the issues that firm's are restricted in exploiting country differences when they develop standardised environmental policies due to stakeholder pressures. More recently, Kassinis and Vafeas (2006) have shown that environmental performance differences can be linked to internal differences in stakeholder groups.

The previous sections have discussed the role of the external environment on the actions of firms from external control, resource dependence, Institutionalist and stakeholder view points. These arguments are associated through many antecedent linkages (e.g. from Institutionalist to stakeholder explanations of legitimacy). The next section provides the bridging theory to product stewardship by briefly considering recent developments in corporate social responsibility and corporate sustainable development thinking.

3.2.5 *Corporate Sustainable Development and Corporate Social Responsibility*

Recent research exploring corporate sustainable development (CSD) has sought to integrate institutional and resource based perspectives in order to explain CSD adoption (Bansal 2005; Hart 1995; Jennings and Zanderbergen 1995). Sustainable development, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987) is an established concept that is beginning to find a place on the management research agenda as a researchable construct .

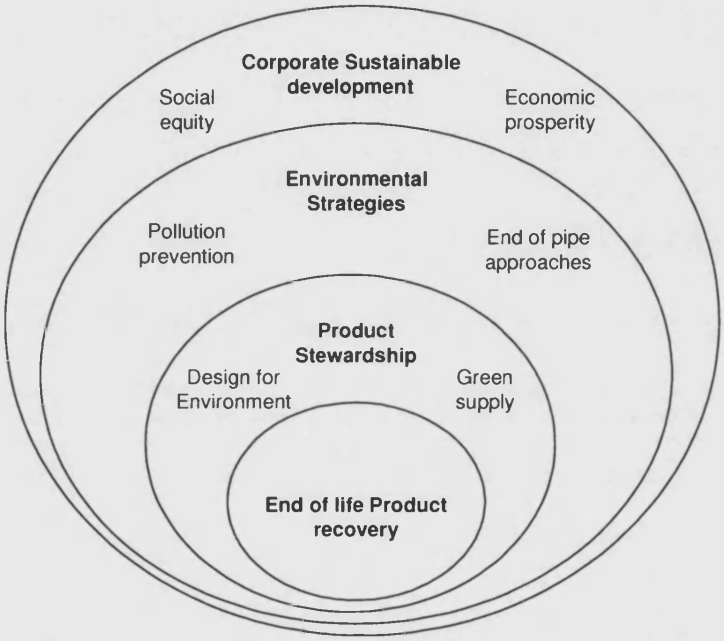

Figure 3-2 Locating product stewardship concepts (Based on Bansal 2005; Hart 1995; Jennings and Zanderbergen 1995)

Corporate social responsibility is discussed by Carroll (1979), who provides the following definition of corporate social responsibility

> *"the social responsibility of business encompasses the economic, legal, ethical and discretionary expectations that society has of organisations at a given point in time" (Carroll 1979 p.500)*

Hence there are strong linkages to stakeholder management theory whereby the organisations are expected to attend to societal issues (this perspective is discussed further in section 3.4). Locating product stewardship within the management literature is not straight-forward. Taking a selection of literature the concept can be situated within CSD and CSR, as one of the environmental strategies that can be taken. Further, product stewardship itself can be sub-divided into design for the environment (including recycling and recovery), green supply and end-of-life product recovery (as shown in figure 3-2).

3.2.6 Product stewardship definitions

Product stewardship appears to be a concept derived from disciplines such as engineering in the examination of the impacts of products over their life cycle, for example the chemical industries focus on the use and disposal of products in the 'responsible care program' (Shrivastava 1995b). A definition that incorporates the life cycle stages is provided as follows "minimise a product's harmful effects on the environment at every stage of its useful life from concept, design, manufacturing, distribution, usage and disposal" (Dutton 1998: 59).

Putting product stewardship in the context of firm strategies and activities Hart (1995: 1001) maintains that

> *"LCA be integrated into the firm's product development process……also suggests that firms take an environmentally proactive stance toward raw material and component suppliers, which is aimed at minimizing the environmental impact of the entire supplier system. Close working relationships among environmental staff, marketing staff, and customers also appear important if the environmental impact of the product-in-use is to be minimized and the spent product reused or recycled."*

These definitions tend to centralise the debate on product stewardship around issues of LCA, when in fact the broader recognition that 'life cycle thinking' is more important to how product stewardship is developed (Lenox and Ehrenfeld 1997; Heiskanen 2002). In fact legislators are incorporating life cycle thinking into new regulations such as the new Integrated Product Policy (Rubik and Scholl 2002). This section will briefly discuss the role of product stewardship in each stage of a product's life as defined by Dutton (1998).

Concepts and design for the environment

Van Weenen and Eekels (1989) state that a product's environmental effects are to a certain extent fixed from the design phase. Thus the decisions taken during this phase need to be investigated if a product's environmental effects are to be reduced. Life cycle analysis (LCA) is a tool used to provide this investigation, and allows the selection of alternative concepts and designs based by comparing them on the basis of ecological criteria (Dewhurst 1993). Recent research has attempted to link the new product development process and environmental strategies in general (Berchicci and Bodewes 2005; Pujari et al. 2004).

Manufacturing

The impact of product stewardship on manufacturing i.e. the reduction of a product's harmful effects during manufacturing, has taken a number of forms. These forms include pollution prevention, waste minimisation, recycling, total quality environmental management, worker involvement, implementation of environmental management systems and supply chain integration (Florida 1996; Gupta 1995; Sarkis 2002; Theyel 2000). The activities used to reduce these effects in manufacturing are summarised below:

- *Waste minimisation* - an organised, comprehensive and continual effort to reduce waste generation through either pollution prevention or recycling (Gupta 1995). Additionally emissions and effluents can be controlled by trapping, storing, treating and disposing of these wastes using pollution control equipment at the 'end-of-pipe', that is, after the waste has been produced (Hart 1995).
- *Pollution prevention* - as part of waste minimisation emissions and effluents are reduced, changed or prevented through better house-keeping, process innovation, or material substitution (Frosch and Gallopoulos 1989; Hart 1995).
- *Recycling* - as part of waste minimisation waste products or emissions may be recycled as a raw material in the same or a different production process, with the intention of recovering and reusing the material or using it for a different application in a manufacturing facility (Gupta 1995).
- *Total quality environmental management* - this is where the principles of quality management - such as the 'plan, do, check, act' cycle[11] - are extended to include manufacturing practices that affect environmental quality (Florida 1996).

[11] Also known as the Deming Cycle.

- *Worker involvement initiatives*- this is where the harmful effects of manufacturing are reduced through self-directed teams, quality circles, process improvement teams and other techniques to empower workers to make process changes (Hanna et al. 2000).
- *Environmental management systems* - Melnyk et al (2003: 332) define an EMS as "the formal system and database which integrates procedures and processes for the training of personnel, monitoring, summarizing, and reporting of specialized environmental performance information to internal and external stakeholders of the firm". This research has shown the implementation of an EMS has been linked to performance improvement in manufacturing firms.
- *Supply chain integration* - new models of supplier relationships and supply chain management that allow opportunities for improved productivity and pollution prevention (Florida 1996). This has been described as green supply defined as *"supply management activities that are attempts to improve the environmental performance of purchased inputs, or of the suppliers that provide them. They might include activities such as co-operative recycling and packaging waste reduction initiatives, environmental data gathering about products, processes or vendors, and joint development of new environmental products or processes"* (Bowen et al. 2001b: 175). Handfield et al (2005) claim that today, environment related supply chain management is not a matter of trade-offs between environmental performance and financial performance.

From this very brief overview of the literature it can be seen that the efforts to reduce a product's impacts at the manufacturing stage do not take a single form, but encompass a number of activities. Each of these may affect organisational and environmental performance in different ways (Sarkis 2002).

Distribution

The reduction of products' impacts during the distribution phase has received relatively little attention by management scholars. The exception to this is the field of logistics in operations management where a small number of studies have attempted to describe and understand the role of logistics in reducing products' harmful effects (Cairns 1998; Goldsby and Stank 2000; Murphy et al. 1996; Skjoett-Larson 2000; Wu and Dunn

1995). Goldsby and Stank (2000) in particular point to the growing role of logistics in the drive to reduce the harmful effects of products through their transportation.

Use

The use phase of a product and its associated environmental effects are often the greatest cause for concern, for example cars use 80% of their lifecycle energy in the use phase and only 20% for the other phases (Chul Kim et al. 2000). Thus activities such as LCA provide a method by which the use phase impacts can be reduced through the design of a product, such as designing a more fuel efficient car (Keoleian and Menerey 1993).

Scholars in the field of marketing such as Kilbourne (1998) provide arguments for addressing marketing practice to reduce environmentally harmful products through the sale of products with lower impacts or increasing information on products' ecological attributes so that consumers can choose ecologically benign products. However, Barrett (1991) argues that although market forces can reward firms that reduce the harmful effects of their products and punish those that do not (through lost sales), market forces are not able to work without intervention from regulation. Thus government-led fiscal measures are needed so that market prices reflect the social costs of products that harm the environment (Jacobs 1991).

Disposal

Another important distinction that is made in the literature is what is meant by disposal. A commonly referred to concept is that products can be dealt with in a variety of ways at the disposal stage. Often called the waste triangle (Figure 3-3), products at this disposal stage can be re-used, recycled (the materials broken down to constituent parts are used in other products), disposal through energy recovery (where products may be incinerated and the resulting energy release is utilised for some other process) and disposal in landfill. Authors also argue that it is more efficient to reduce resources at the point of use, rather than the previously mentioned options and so the pinnacle of the triangle should be the ultimate goal.

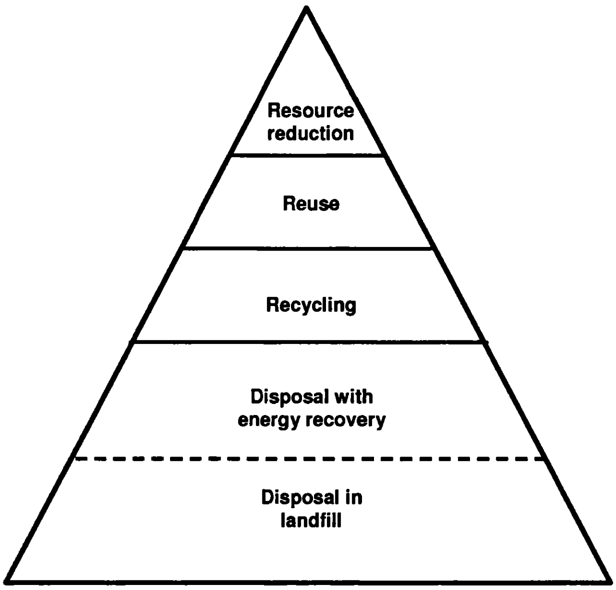

Figure 3-3 The waste strategy triangle (Carter and Ellram 1998: 92)

It is the disposal stage of a product's life that forms the basis of this research whereby the research aims highlight end of life product recovery as being an area in need of more exploration. Traditionally, manufacturers reduce the disposal impacts of their products through concepts and designs that consider these impacts before products are created (Dewhurst 1993). Spicer and Johnson (2004) explain that extended producer responsibility actually takes product stewardship further by suggesting manufacturers are responsible for the take-back, recycling and final disposal of the product. Pohlen and Farris (1992) examined this issue some years before and demonstrated that products usually do not return back through the same channel in which they were produced, but new reverse channels are needed to take-back, recycle and dispose of products at the end of their lives. This has led to the concept of reverse logistics. Reverse logistics has been defined from the business perspective as

> *"the role of logistics in product returns, source reduction, recycling, materials substitution, reuse of materials, waste disposal, and refurbishing, repair and remanufacturing" (Stock 1998: 20).*

The role of reverse logistics within industry is seen as equivalent to the role of inbound logistics when outbound was of the primary concern, due to the large amounts of resources associated with finished goods inventories. Just as inbound logistics was developed in recognition of its importance, so too is reverse logistics receiving greater attention both in the management of operations theory and practice (Stock 1998).

Other definitions of reverse logistics include

> *"The process whereby companies can become more environmentally efficient through recycling, reusing, and reducing the amount of materials used" (Carter and Ellram 1998: 85)*

or in a more inclusive definition,

> *"the process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of capturing or creating value or proper disposal" (Rogers and Tibben-Lemke 2001: 130).*

Roger and Tibben-Lemke (2001) state that in its broadest sense reverse logistics includes products sent back due to damage, seasonal inventory, restocking, salvage, recalls and excess inventory. They go on to explain that the specific activities associated with reverse logistics include reselling, remanufacturing, recycling, landfilling and repackaging. The role of reverse logistics in product stewardship then is primarily concerned with the reduction of harmful effects of products at the disposal stage of a product's life, thus the Carter and Ellram (1998) definition appears most suitable for this purpose.

This section has described product stewardship in its various forms and the types of activities that firms will typically engage in when implementing a product stewardship strategy. To summarise product stewardship is the activity involved in minimising the environmental impact of a product throughout its life from conception to disposal. The environmental impact is taken to mean the narrow sense of the 'natural environment' and thus the ecological damage and not the general environment external to firms. This differs from the broader term, sustainability, which encompasses the economic, social and environmental impact of firms (Lamming et al. 1999). Hence product stewardship in the sense used here focuses on the ecological damage of products. This discussion however does not answer a fundamental question, why do firms adopt product stewardship strategies and of the various activities involved which of them will be used?

3.3 Drivers to adopt product stewardship strategies

Fischer and Schot (1993) state that firms implementing environmental strategies will typically do so as a result of changes in external pressures such as new legislation. Responses to external pressures can be viewed from a number of theoretical perspectives, thus from a strategic choice view Porter (1985) surmises that a firm's responses are the result of rational, deliberate, premeditated and orderly decision making at the corporate level. General managers are thought to anticipate future threats and opportunities, engage in sound strategic analysis, set strategic objectives, and develop and dynamically allocate resources to implement strategy (Porter 1985, 1991; Wernerfelt 1984). Management scholars have questioned this explanation however, demonstrating that the process of strategic decision-making is not so straight-forward. For example, the behavioural school of thought does not support the view that managers are able to act so rationally (Simon 1957, 1979). In fact March (1988: 573) suggests that

> *"organizations do not always have a well defined set of objectives; their preferences are frequently ambiguous, imprecise, inconsistent, unstable and affected by their choices. As a result, problem-solving and decision-making assume some of the features of a garbage can process, learning becomes confounded by ambiguity of experience, and actors become particularly sensitive to the participation and attention patterns of organisational actors".*

Thus firms' responses can be seen as both strategic choices subject to rational processes, and also the result of ill-defined sets of objectives. What is clear is that the process of responding to external pressure is not straight-forward, as Fisher and Schot (1993 p.3) summarise "the relationship between changes in firm behaviour and external pressures is complex and subtle". This next section examines the main theoretical explanations for why firms adopt product stewardship.

According to Bansal and Roth (2000) the types of ecological responsive initiative depend on the type of ecological pressure (as shown in figure 3-4). In their model, Bansal and Roth (2000) propose that these pressures can be sub-divided into three distinct groups: Legitimacy, competitiveness and environmental responsibility pressures on firms. Although their model does not explicitly provide an explanation of product stewardship as a response, it does comprise elements of product stewardship as shown on the right hand side of figure 3-4 (e.g. green products, LCA and regulatory compliance).

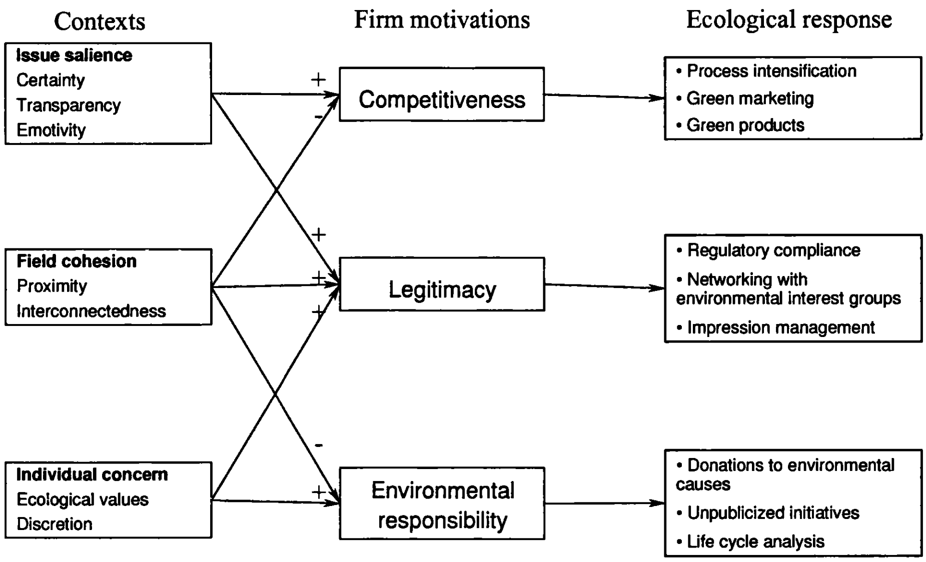

Figure 3-4 The relationship between ecological and ecological responses (from Bansal and Roth 2000 p.729)

The Bansal and Roth (2000) model suggests that the activities associated with product stewardship, all shown on the right-hand side of the model, are driven by three sources of motivation. The responses, that appear not to correspond to the previous definition of product stewardship relate to donations to environmental causes, networking with interest groups and impression management (shown on the right of the model).

In their model of ecological responsiveness, one of the key theoretical contributions Bansal and Roth (2000) make is the context under which ecological pressures are derived. These contexts correspond to three levels, the ecological level comprising issue salience, organisational field level comprising field cohesion (how well firms in an industry are connected) and the individual level comprising individual concern (based on the values and discretion of managers). Their model states that the more salient the issue, the greater the competitiveness and legitimacy pressures on firms. If field cohesion is greater, competitiveness and responsibility are less strong as pressures but legitimation is greater. Individual concern of managers leads to greater environmental responsibility and legitimation pressure, but has no relationship to competitiveness.

There are limitations to their model however, especially in providing a basis for explaining differences in firm behaviour. Although Bansal and Roth recognise that multiple motivations may lead to a particular response, equifinality may be present in the responses shown by firms[12] thus limiting the predictive power of the model. Additionally, Bansal and Roth could not test for the relative strength of the three types of pressure. Purely taking an external view (such as the industry structure view as proposed by Porter 1985) is limited in that idiosyncratic differences in firm resources are not catered for. However, despite the limited predictive nature of the model, Bansal and Roth do provide a clear, empirically derived description of the types of ecological pressure. Other research has also suggested origins of the drivers for firms to take up product stewardship activities for example in the areas of manufacturing and logistics as discussed next.

Focusing on manufacturing firms in the USA, Florida (1996) found that the key factors driving changes in manufacturing strategy to reduce the harmful effects of production were regulations, closely followed by corporate citizenship (meeting stakeholder expectations). Factors related to competitiveness were shown as less important to these strategies but included improving technologies, serving key customers, productivity improvement and markets for green products was the least important reason. From the perspective of distribution logistics Murphy et al (1996) showed that the reasons for developing environmental policies include compliance with regulations as most important, and less important were the control of environment-related costs, minimising liability, keeping up with competitors, societal expectations and profit opportunities.

Explicitly examining reverse logistics for end-of-life products Carter and Ellram (1998) propose there are a number of reasons for firms to be involved. For example some firms are engaging in product recycling activities for environmental and cost benefit reasons and to proactively minimise the threat of government regulation and to improve corporate image (Carter and Ellram 1998). Evidence contrary to this shows that despite voluntary efforts to recycle cars in Europe, the ability to minimise the threat of legislation in reality has proved difficult, as Europe-wide regulations continue to be implemented to raise recycling to standards higher than those set voluntarily (Orsato et al. 2002).

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[12] As discuss in chapter 2 in the critique of the RBV

Carter and Ellram (1998) argue that drivers of reverse logistics can be described as four types. These are regulatory, competitive, input (suppliers) and output (buyers). From the perspective of Bansal and Roth's ecological pressures, the first 'regulatory' driver reverse logistics corresponds to ecological legitimacy, supporting the general view on ecological pressures.

> *"the regulatory sector has received the greatest attention, and is generally credited as having the greatest influence on a firm's reverse logistics activities" (Carter and Ellram 1998: 95).*

From this Carter and Ellram imply that firms should concentrate on working with other companies within each industry to lobby and proactively work with regulatory agencies. The other three pressures; competitiveness, suppliers and buyers, are proposed by Carter and Ellram to be of lower importance. It should be noted that typically last owners of products are not willing to pay for recovery of their waste (Rogers and Tibben-Lemke 2001). However, Carter and Ellram argue that if pressure from consumers exist in relation to end-of-life products, firms should concentrate on green marketing and closer relationships with retailers.

The following section discusses the three motivations for ecological responses derived by Bansal and Roth, supported by other studies and applied to the context of product stewardship.

3.3.1 Competitiveness motivations

The view that tackling ecological issues damages industrial competitiveness was first seriously countered by Michael Porter in 1991, who stated that pollution was simply a waste that diminished the value created by firms. Following this view management researchers have argued that by becoming more efficient, firms can reduce costs while at the same time reduce environmental impacts through the reduction of inputs, resources and cutting waste disposal, for example through recycling (Porter and van der Linde 1995; Reinhardt 1999; Shrivastava 1995a).

Early empirical studies showed that cost reduction is the main component of economic motivations for environmental practices tied to process improvement such as pollution prevention (Stead and Stead 1992). Many actions to reduce cost and environmental impact concurrently have centred round manufacturing operations (Klassen 1999; Klassen and Whybark 1999). However the economic benefits of responding to ecological pressures appear not to be limited only to manufacturing. A growing number of researchers suggest that profits and revenues can also be improved through green marketing, waste sales, the outsourcing of environmental expertise and product differentiation which supports the broader scope of product stewardship outside of manufacturing although the evidence is weak (Cordano 1993; Hart and Ahuja 1996). Examining recycling of products Roy and Whelan (1992 p.63) propose that the benefits to corporations are: image to market, identification of employees with company, preparedness for future legislation, and liabilities, reduced disposal costs during manufacture, improved material economics by recycling manufacturing and end-of life product waste and the reduced dependence on availability of disposal means through recycling.

Management scholars have attempted to show a positive link between environmental performance and financial performance. The success of these studies to demonstrate this link is varied, although they often take a similar theoretical perspectives such as a 'black box' view of firms (Klassen and McLaughlin 1996; Klassen and Whybark 1999) or a strategic level resource-based view of firms (Christmann 2000; Hart and Ahuja 1996; Russo and Fouts 1997). A wide spread of measures are used to ascertain environmental performance in these studies from FRDC[13] rating, the TRI[14] database, scales based on the level of proactivity[15] and number of environmental options implemented. However these studies have not explored the relative differences between the different aspects of products stewardship with most research either examining the strategic level of performance or only concentrating on manufacturing and not other aspects of product stewardship.

To summarise, maintaining and building competitiveness is argued to be a significant motivation for firms to be engaged in product stewardship activities at all stages of a product's life. However, evidence to show that improved environmental performance leads to greater financial performance is still unclear and this lack of clarity may be partly due to the variety of measures of environmental performance. A reduction in production costs is seen as one of the key outcomes of reducing the harmful effects of

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[13] A third party environmental ranking scheme devised for the investment community

[14] Toxic Release Inventory in the USA, a database of firms' polluting emissions

[15] A number of scales exist to measure environmental proactivity J.L. Hass, 'Environmental ('Green') Management Typologies: An Evaluation, Operationalization and Empirical Development', *Business Strategy and the Environment,* 5/1 (1996), 59-68..

product manufacturing, but evidence is generally weak. Evidence is especially poor to show that firms gain competitive advantage from concepts and designs that reduce harmful effects or from products that have lower impacts in the use and disposal stages of a product's life. Although Bansal and Roth (2000) suggest competitiveness as a distinct pressure motivating firms to respond, there is a clear link to the need to maintain legitimacy. Walley and Whitehead (1994) explain the impact of not gaining legitimacy, i.e. by not complying to legislation, is often a direct financial one due to fines, penalties, punitive damages or even a withdrawal of a licence to operate .

3.3.2 Legitimacy pressures

Suchman (1995) describes legitimation as the desire of a firm to improve the appropriateness of its actions with regard to established regulations, norms, values and beliefs. In support of this statement Oliver (1991) purports that the sets of rules set down by legislation are internalised by firms and this determines their actions through strategic responses for achieving legitimacy. This view harks back to the perspectives taken in the resource dependency and institutionalist views (DiMaggio and Powell 1991; Pfeffer and Salancik 1978). In the case of environmental legislation this can be seen through dedicated environmental personnel and departments to ensure compliance (Prakash 2000). Specifically acting on the need to gain legitimacy is proposed to

> *"allow companies to get ahead of the regulatory curve. These strategies give companies a firmer legal footing and may allow industries to pre-empt some regulations" (Shrivastava 1995b: 955)*

Ecological legitimacy is not only gained through complying with environmental legislation, but less formally structured social pressures exist such as those represented by the concept of stakeholders. Thus an ecological response

> *"is also good for a company's public relations and corporate image. It can help companies both to establish a social presence in markets and to gain social legitimacy" (Shrivastava 1995b: 955)*

Stakeholders are said to have varying influences from an ecological perspective depending on the type of stakeholder, varying from indirect to direct influences. For example in their study, Madsen and Ulhoi (2001) demonstrate that whilst legislators and regulators are seen as having a direct influence on firms, others such as the media are more indirect influencers. Taking this idea further, research by Henriques and Sadorsky

(1999) show a link between stakeholder types and levels of environmental response. While more proactive firms perceive all environmental stakeholders as important with the exception of the media, less proactive firms only feel the media are important stakeholders.

Although stakeholder theory does offer a partial explanation for ecological pressures, some theorists have argued that stakeholder theory is explained by contractual arrangements as described in transaction cost economics (Key 1999). However, how these contracts are conceived in terms of economics is unclear as ecological stakeholder issues often deal with intangibles and the external costs of production (Jacobs 1991).

The utility of the neo-institutional perspective further explains the role of legitimation in firms responding to ecological pressures, as demonstrated by a number of institutional explanations for why firms respond to ecological pressures (Jennings and Zanderbergen 1995; Prakash 1999). For example, research has shown that mimetic isomorphism (firms copying the behaviour of other firms) occurs within industry groups to both maintain legitimacy by imitating successful ecological strategies and to minimise the risk of being a first mover in a new market (Bansal and Roth 2000; Prakash 1999).

One of the critical arguments against acting on the need to gain legitimacy is the cost to do so. The cost entailed in complying with legislation can be great with some authors such as Walley and Whitehead (1994) stating that environmental compliance is always a cost to firms overall. Business has tended to be resistant and defensive on the whole towards addressing the natural environment and sustainability (Irwin and Hooper 1992). Baumol and Oates (1988) argue that this is due to the command and control nature of environmental laws and the potential distorting effects they have on market mechanisms. Research has shown that the increase in production costs due to environmental regulation is thought to be 2%, but varies widely across industry types (Luken 1997). To counter this problem, legislation is developing that is more flexible and allows firms some discretion in responding (Sauer et al. 2001). This provides a solution to Jennings and Zanderbergen's (1995) Institutionalist problem of isomorphism (compliance to the same legislation in the same way) potentially limiting innovation, as greater freedom is given to firms in their choice of response.

In summary, firms gain legitimacy by conforming to social norms and standards. Firms are either forced to do so by specific regulation or perceive some other kind of benefit in doing so, typically relating to public image or reputation. Firms often copy other firms' responses to legitimacy pressures in order to reduce the associated risks such as increased costs. Costs are often associated with meeting standards and regulations and strict adherence to these may also stifle innovation, limiting firms' ability to gain competitive advantage. However, voluntary codes can provide greater flexibility for firms to meet societal expectations and at the same time gain competitive advantage by implementing different responses to their competitors. Bansal and Roth (2000) propose that ecological pressure comprises not only of legitimacy and competitiveness motives, but also by the sense of individual environmental responsibility and this is discussed next.

3.3.3 Environmental responsibility

Explaining further, Bansal and Roth argue that other responses such as redeveloping green areas of land, providing a less profitable green product line and use of recycled paper are more due to a sense of social obligation, responsibility and philanthropy rather than due to self-interest (such as gaining competitive advantage). Their study however provides few examples of how environmental responsibility may motivate product stewardship activities, if at all.

One exception is that according to the Bansal and Roth model LCA is motivated primarily by environmental responsibility. They argue that there are no specific competitiveness or legitimacy reasons for carrying out LCA, there are no legislative mandates and the additional cost of analysing a product's life cycle does not provide specific competitive benefits. However there was only one example in their data to support this assertion, thus the idea that LCA is only driven by the ethical aspects of ecological responsibility should be viewed with caution.

To conclude this section, theoretical models validated through empirical studies such as that developed by Bansal and Roth (2000) suggest that firms are motivated to respond to ecological pressures for a number of distinct reasons. Firms account for their competitive situation, the need for organisational legitimation and the individual concern of managers when responding to ecological imperatives. Depending on the combination of motivations different responses appear to be enacted. However these models do not consider the role of internal factors in the explanation of differences in how firms respond nor do these models explain their ability to gain advantage from these responses. Theoretical contributions that attempt to address this gap are discussed next.

3.4 Gaining benefits from product stewardship

The statement that product stewardship is of benefit to firms, other than merely compliance to regulation, is part of the current debate on whether environmental performance and firm performance are linked. A brief review of the literature will reveal, as suggested earlier, that there is a mix of evidence for and against this link, and that there is no consensus that undertaking product stewardship activities will automatically lead to positive returns for firms as debated by Walley and Whitehead (1994). The following section will review these studies and discuss the merits of the models used to link organisational and environmental performance in product stewardship. Furthermore by taking a resource-based view of the firm, differences in the variety of responses made by firms can also be related to the idiosyncratic make up of resources and capabilities within firms. Therefore this section starts with a discussion of Hart's natural resource based view, followed by a number of studies that have built on or developed further Hart's proposed role for capabilities in environmental strategy and firm performance[16].

Early studies into the relationship between corporate social performance and firm performance (usually financial performance) showed that there appeared not to be a relationship at least not using the set of measures selected (Aupperle et al. 1985). However, concentrating on the issue of environmental performance (and omitting the social dimension) Porter and Van Der Linde (1995) proposed that in fact there may be a significant, positive relationship.

The first conceptual model that provides an explanation of the links between the types of response such as pollution prevention and product stewardship, is that developed by Hart in his 1995 Academy of Management article. This model provides the basis of many further empirical investigations into the links between environmental performance and organisational performance and is discussed next.

[16] The RBV has been criticised by a number of authors as discussed in chapter two, but remains a common explanatory perspective for firm differences in the area of ecological responses and the links to competitive advantage.e.g. Hart and Ahuja (1996), Russo and Fouts (2000), Christmann (1999) and Sharma and Vredenburg (1998).

3.4.1 *The natural resource-based view*

Hart takes the Resource-Based view of the firm in his explanation of how firms can gain competitive advantage from ecological responses[17]. In his model he identifies three main strategies: pollution prevention, product stewardship and sustainable development[18]. With respect to product stewardship Hart argues that the strategies that develop in firms are path dependent and embedded. The path dependency of product stewardship means that firms need to implement elements of pollution prevention before they can adopt product stewardship and that sustainable development is dependent on capabilities developed for product stewardship. Furthermore the ability of firms to gain advantage from implementing these strategies is dependent on the resources and capabilities the firm possesses following the arguments of Wernerfelt (1984) and Barney (1991), as discussed in chapter two. The following figure is replicated from Hart's 1995 paper and integrates these relationships into a conceptual model of sustained competitive advantage (Figure 3-5).

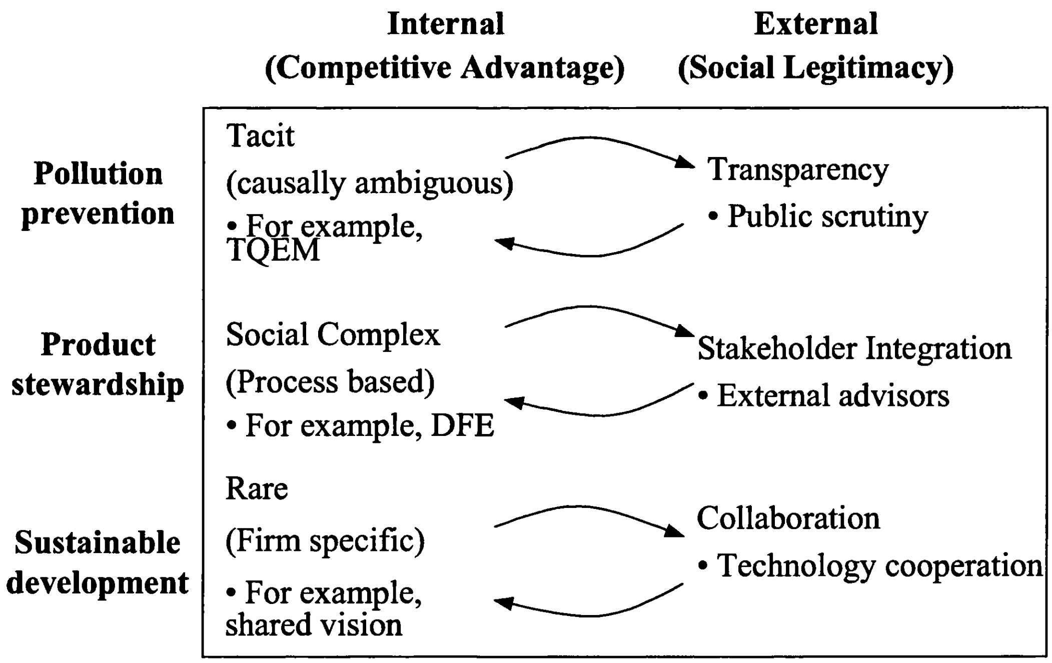

Figure 3-5 Hart's Natural RBV model (1995)

[17] The resource based perspective is discussed in detail in chapter two

[18] Which Hart (1995) defines as severing the negative links between environment and economic activity in the developing countries of the South, although other authors have argued that this is not the role of firms but governments R.C. Lamming, A.C. Faruk, and P.D. Cousins, 'Environmental Soundness: A Pragmatic Alternative to Expectations of Sustainable Development in Business Strategy', *Business Strategy and the Environment,* 8 (1999), 177-88..

Within this model Hart argues that two principle aspects need to be developed for product stewardship to provide competitive advantage and external social legitimacy. These aspects are stakeholder integration and socially complex capabilities, which he defines as within the design and concept stage of the definition of product stewardship. Hart (1995: 1001) defines stakeholder integration as the ability to integrate the perspectives of key external stakeholders into decisions on product design and developments. Hart's main argument for advantage centre round competitive pre-emption whereby firms implement strategies before they are forced to do so by legislation and therefore can mould the shape of regulation to fit their own model. Once legislation is implemented these pre-emptive firms are also ahead of other firms in the learning curve. Shared vision may also enhance PS if it exists by attaining a 'commitment to a general direction' from a number of stakeholders and so leading to social legitimacy. Hart describes path dependence as an important part of social legitimacy, for example if firms pursue product stewardship without first accumulating pollution prevention capabilities, the manufacturing stage may not support green products, exposing credibility and creating reputational risks. Product stewardship is also proposed to be embedded in other activities, thus pollution prevention may be facilitated by changes in product design, thus embedded with product stewardship.

Overall Hart provides a convincing argument for how firms can gain competitive advantage from product stewardship if the right set of capabilities are developed. However his definition of product stewardship is narrow focusing primarily on the design of products, thus the impact of stakeholder integration and shared vision is not specifically explored within areas such as supply management, distribution and product disposal. In order to expand on Hart's theoretical contribution Sharma and Vredenburg (2003) developed an empirically derived model relating capability development and environmental proactivity.

3.4.2 Capabilities from environmental strategies

The model that Sharma and Vredenburg (1998) develop links environmental proactivity[19] (a strategy variable), with organisational capability and organisational benefits. The proactive environmental strategy variable that Sharma and Vredenburg

(1998) develop was made up of ten measures to determine the level of proactivity of the strategy. The capability variable measured the extent to which capabilities developed as a result of environmental response, following the attributes given by the RBV such as inimitability. The benefits variable covered competitive benefits including lower cost, better operations performance and improved quality and are a good indication of the benefits of environmental responses derived from an empirical source. Thus the model predicts how proactive environmental strategies lead to capability development and how these in turn lead to competitive organisational benefits.

The two hypotheses that developed from this question were,

> *"the greater the degree to which a company adopts proactive environmental responsiveness strategies, the greater the likelihood that firm-specific organisational capabilities will emerge"*
>
> *"The greater the degree to which firm-specific organisational capabilities emerge within a company, the greater the likelihood of competitive benefits flowing from these capabilities"*

Thus their model could be represented as follows (Figure 3-6)

Figure 3-6 Model of Environmental strategy and capabilities

In testing their model on a sample of oil and gas industry companies[20] in Canada, Sharma and Vredenburg find that there is a statistically significant link between their measure of proactive environmental strategy and the development of competitively valuable capabilities (based on their emergent capabilities and the accepted definitions of capability characteristics). They also find that these capabilities are linked to organisational benefits such as cost reduction. However the contribution of each type of capability is not explored and how these individually affect benefits is not discussed. Equally the measure of proactive strategy does not distinguish between different product stewardship activities and would be limited if applied to product stewardship in

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[19] Proactivity is a measure of the 'level of environmental strategy' which has variously been described along a continuum from reactive to proactive, or as part of discrete categories, for a discussion of these measures see Hass (1996).

its various forms. In order to overcome this limitation to theoretical scope of the links between proactive environmental strategy and capability development Bowen et al (2001) apply the ideas to one aspect of product stewardship, green supply.

3.4.3 Capabilities for green supply

Taking the hypothesis that capabilities develop as part of an ecological response as demonstrated by Sharma and Vredenburg (1998), Bowen et al (2001) introduce a model linking supply chain capabilities with green supply chain capabilities. This is again based on the RBV rationale and the capabilities literature, linking into supply chain management research.

The model presented by Bowen et al is shown in figure 3-7 and demonstrates that positive relationships exist between the development of green supply capabilities, proactive environmental strategies, supply capability and strategic level of purchasing and supply (as shown by the + symbols, arrows without this symbol denote a tested but not significant relationship).

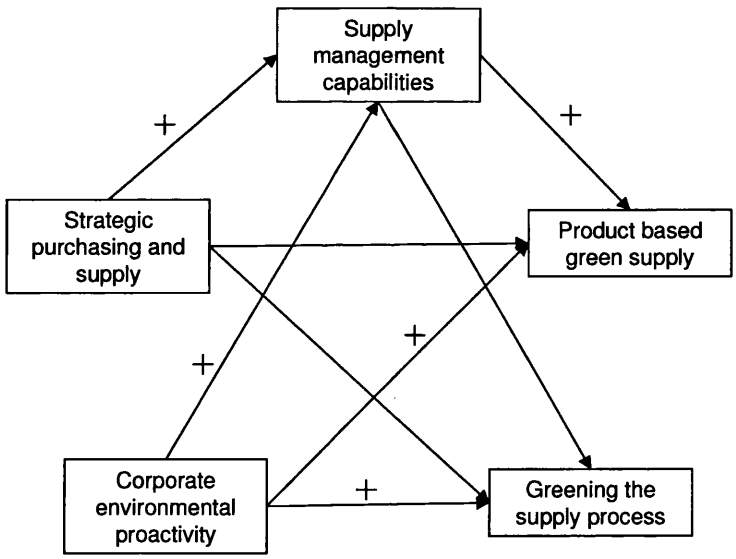

Figure 3-7 Model of green supply (Bowen et al 2001)

Bowen et al (2001) distinguish between two types of green supply capabilities: the capability for product-based green supply and the capability for greening the supply process. Product-based green supply is akin to the supply chain issues of product stewardship as described earlier and is the shown to be related to corporate

[20] This restricted sample limits the generaliseability of the statistical empirical findings.

environmental proactivity and supply management capabilities. However product-based green supply was not found to be related to the level of strategic purchasing and supply, as this alone is proposed to be insufficient to trigger a green supply response. Despite a number of limitations, this study does provide the first evidence that capabilities developed at the sub-organisational level are linked to proactive environmental strategy.

Applying the Bowen et al model within the context of the RBV explanation is only partial as the authors did not test the relationships between the capabilities for green supply and competitive advantage (or organisational benefits, as used by Sharma and Vredenburg 1998) and the links to how this may occur were not made clear.

> *"we did not attempt here to extend our work in a way suggested by resource-based theory to the relationships between the existence of particular capabilities, capturing competitive advantage and performance. This work remains to be done in the green supply context." (Bowen et al. 2001b: 187).*

The researchers of this green supply study suggest that the concepts of capability building could be applied to other sub-organisational areas such as green manufacturing to ascertain if other capabilities develop in these areas. The model also does not address other areas related to product stewardship such as reverse logistics.

3.4.4 Factors for successful reverse logistics operations

Collaboration is seen by Roy and Whelan (1992: 71-72) as vital to gaining value from product recycling stating "product stewardship[21] demands collaboration among involved companies in the value chain". However the theoretical basis for this assumption is lacking in the management literature. In order to address the gap in the management literature concerning reverse logistics as part of product stewardship, Carter and Ellram develop a conceptual model of reverse logistics from previous literature to explain the drivers and constraints to successful reverse logistics. Although this model does not explicitly take a RBV of the firm (or any specific management theory perspective) in the context of reverse logistics, it does propose a number of factors that successful reverse logistics is dependent on as developed in previous research. Their model is shown in the following figure 3-8.

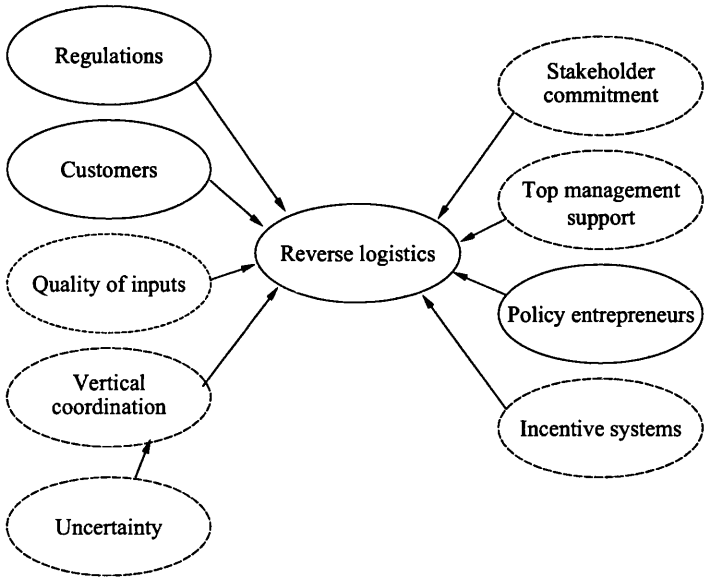

Figure *3-8* Model of the drivers and constraints of reverse logistics (Carter and Ellram 1998)

Carter and Ellram's model shows that successful reverse logistics programs are driven by - as discussed in the previous section of ecological pressures - and constrained by the concepts shown in *Figure* 3-8. Thus regulations and customers are the key external drivers, which relate to legitimacy and competitiveness pressures described earlier. An internal driver is described as policy entrepreneurs, such as managers who support the program and believe it is the right thing to do, which relates to Prakash's (1999) view that beyond compliance policies require managerial discretion and autonomy.

The success of a reverse logistics program is thought to be dependent on a number of other factors. These are described by Carter and Ellram as the quality of inputs, vertical co-ordination, stakeholder commitment, top management support and effective policy entrepreneurs. This model also agrees with previous literature on gaining benefits from proactive ecological responses, such as the need for stakeholder integration and internal support from top management as well as effective managers, again supported by Prakash (2001). However, specific to reverse logistics are the quality of inputs and vertical co-ordination. A number of authors have stated that the quality of recycled material inputs needs to be high to compete with virgin material even if the cost is lower (den Hond 1996; Roy and Whelan 1992). Carter and Ellram propose that the greater the

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[21] Roy and Whelan focus their study on the responsible disposal of products, re-use and recycling of material.

level of co-ordination between buyers and suppliers, the greater level of reverse logistics. Related to this is that where the input sector is uncertain, there will be a greater requirement for buyers to co-ordinate with suppliers, supported by Williamson's (1981) ideas of uncertainty leading to integration.

The Carter and Ellram (1998) model ignores the RBV rationale that firms gain advantage from a set of firm-specific capabilities and the natural RBV argument that capabilities develop out of proactive environmental strategies. Furthermore some of the factors are underspecified, for example Aragon-Correa and Sharma (2003) propose that uncertainty can take the forms of state, decision response and organisational effect[22]. The level of vertical coordination is also a complex concept - as discussed in chapter two - and differing approaches to how this is used as a concept may also affect the assessment of the success of reverse logistics operations.

Despite the limitations of this model, Carter and Ellram provide the first set of theoretically derived external and internal factors that affect whether a firm can implement a successful reverse logistics operation. Thus the model contributes to the thinking on how firms can gain benefit from product stewardship at the end of a product's life. A last point is that all the proposed links between the factors require empirical investigation.

Taking the concept of vertical coordination for reverse logistics further leads Toffel (2002) to develop a model of integration of product take-back, using the TCE explanation. Toffel describes a number of types of arrangements between product manufacturers and product recyclers ranging from integrated in-house operations, through long-term contracts or joint ventures to completely market-led arrangements carried out by third parties (Toffel 2003). Figure 3-9 outlines Toffel's explanation, and although again this has not been empirically tested it does provide one explanation for the strategy taken either to outsource, integrate or provide a hybrid governance mechanism.

[22] They argue that uncertainty in the general business environment leads to managers taking more risks and use more innovative strategies, uncertainty of decision responses and organisational effects leads to difficulties in allocating sufficient resources to an issue, thus these types of uncertainty may lead to different outcomes either enabling or inhibiting the development of a proactive environmental strategy.

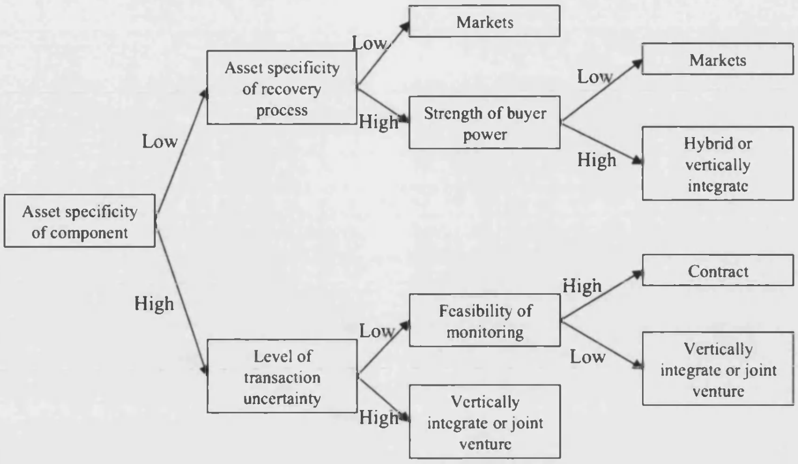

Figure 3-9 A TCE explanation of integration in product recovery strategies (Toffel 2002)

Toffel (2002) argues that vertical integration in reverse logistics - what he calls end-of-life product recovery - can be explained using the TCE rationale. Using the behavioural assumptions of TCE and the key concepts of asset specificity, uncertainty and transaction frequency, Toffel predicts how manufacturers will organise reverse logistics with respect to integration. The concept of asset specificity is used in two forms. The first is the specificity of the recovered component, where one OEM may value a recovered component more than other potential customers (i.e. because it can be re-used in new products). The second type is asset specificity in the recovery process where product-specific human resources or physical assets are used to gain cost efficiencies, but where these assets cannot be used for other products. Simply put, Toffel argues that where asset specificity, of both types is high, the recovery process will be integrated, and where it is low the process will be left to the market. However, combinations of these types of specificity may lead to alternative forms such as hybrids as defined by Williamson (1991).

As shown in figure 3-9, in addition to the effect of asset specificity, the interaction of uncertainty and the related idea of feasibility of monitoring also affects the decision to outsource or integrate the process. Considering the concept of uncertainty, Toffel (2002 p.10) concurs with Carter and Ellram (1998) stating that "greater environmental uncertainty will lead to increased vertical coordination among suppliers and buyers....However, even when uncertainty is low, contracting will only occur when monitoring is feasible".

In summary, collaborative relationships that correspond to joint ventures or hybrids are predicted when uncertainty is high and either the component or process asset specificity is high. Thus these types of more collaborative relationships in product stewardship (not based on purely market or hierarchical governance structures) are expected under specific conditions. It must be noted however that the usual criticisms of TCE apply to this explanation. Thus the assumptions of opportunism may be over-stated as shown in chapter two. Furthermore, the fact that product recovery may be mandated by legislation is not accounted for in the model. This theoretical perspective does provide an explanation of whether manufacturers will integrate or outsource product recovery, yet it does not explain how capabilities may be developed that firms can exploit for competitive advantage as proposed by Hart (1995).

The theoretical perspectives on product stewardship indicate - to a greater or lesser degree - that the development of relationships between firms, and between firms and other organisations, have an impact on the selection and implementation of strategies. The next section briefly outlines additional research which has informed the debate on relationships developed for ecological reasons otherwise known as environmental partnerships.

3.5 Environmental partnerships

So far the discussion of the literature has primarily focussed on vertical relationships between firms. Yet research in the field of environmental strategy often highlights other types of collaboration in addition. With regard to other forms of collaboration that are related to product stewardship, Hart (1995) viewed stakeholder integration as dealing with other organisations with non-economic goals such as interest groups or environmental pressure groups. These types of relationships have been described as environmental partnerships (Arnold and Long 1992).

Westley and Vredenburg (1991) describe the case where an environmental group endorses a line of green products of a retailer. They argue this form of collaboration - 'strategic bridging' - occurs when the problem area (green products in this case) is under-organised and the willingness of stakeholders to collaborate is low. While this is predominantly a behavioural perspective of the firm, Conway and Steward (1998a) describe twenty cases of environmental innovation (related to reducing a product's harmful environmental effects through the product development process) stating that drivers were primarily regulatory. Customers and suppliers were shown to be important to the innovation process, as were universities and research organisations in some cases. However the nature of the relationships were not explored in this study. Specifically related to product stewardship Roy and Whelan (1992) describe an advisory group made up of material producers, manufacturers, retailers, reclamation firms, local authorities, research organisations and government. This group provided information exchange, sharing of best practice and initiated 'collaborative ventures'. The study however provides no link to management theory.

Organisations involved in environmental partnerships are often not economic entities e.g. firms as defined in the economic literature (Arnold and Long 1992). Relationships with these organisations, such as pressure groups, are not included in this review of the literature as they do not have a direct influence on product stewardship operations because they are not part of the processes involved in reducing a product's harmful effects on the environment. The collaboration literature reviewed in chapter two concentrated on the relationships between firms and it is this meaning of collaboration that is adopted here. It is worth noting however that relationships with entities with non-economic goals do represent a means by which firms can gain social legitimacy from their product stewardship activities and as such have a role to play as proposed by Hart (1995).

3.6 Conclusion

While many studies have taken a resource-based perspective on environmental performance, the application to product stewardship is limited due to the concentration of works at the corporate strategy level. The links between product stewardship and organisational benefit are limited to only a few studies and conceptual papers. In the area of product design and concepts this review found few studies linking DFE and LCA with organisational benefits (see Pujari et al 2003). The manufacturing stage has attracted a number of empirical works linking 'green manufacturing' and organisational benefits but the evidence for a positive link is generally weak (for example see Hart and Ahuja 1996). The purchasing and supply activities at the manufacturing stage has been explored but further development and testing is required here as demonstrated by the Bowen et al (2001) study, with few studies taking this further (Rao and Holt 2005; Zhu et al. 2005). Product distribution has been explored in the area of logistics management, but links to organisational benefits have yet to be established. Finally regarding end-of-life products, conceptual work has provided a theoretical backdrop that requires further empirical research for example in the developing field of reverse logistics (Prahinski and Kocabasoglu 2006).

This chapter has reviewed the main literature contributions that explain the nature of product stewardship, why firms implement product stewardship, and how firms may gain benefits from implementing product stewardship. Product stewardship is the reduction of a product's harmful effects on the natural environment at every stage of its life, which leads to the consideration of these effects in the conception, design, manufacturing distribution and disposal stages of a products life.

Firms engage in the various aspects of product stewardship to account for their competitive situation, the need for organisational legitimation and the individual concern of managers when responding to ecological imperatives. Evidence to support a link between organisational benefits and product stewardship is limited. Much of this evidence is based in the strategy literature, which inadequately focuses on product stewardship as a concept. Although conceptual models have been developed for overall corporate level environmental strategy and some aspects of product stewardship, such as green supply and reverse logistics, empirical explanation and validation is still in its infancy.

The next chapter draws on the conclusions of this literature review to develop a conceptual model that links collaboration and product stewardship and research questions that can be used to inform the debate and to explore the gaps in current knowledge.

SECTION TWO

Chapter 4 A Conceptual framework of collaboration and product stewardship

4.1 Introduction

This chapter aims to link the contributions in the previous two chapters on perspectives of the firm, collaboration between firms and product stewardship, and thus derive research questions to explain the role of collaboration for product stewardship. The chapter continues by developing a conceptual framework relating the key concepts described in the literature review and setting the framework within which the research questions are developed. The conceptual framework of collaborative relationships and product stewardship can only be partially specified from empirical work previously undertaken, and so the gaps are identified. The research questions are then developed to provide new research directions based on the gaps in the conceptual framework.

4.2 Synopsis of the literature review

The previous chapters described the existence and function of firms, how they differ and why. This discussion included the decision to collaborate between firms and the different forms this can take. The discussion then moved on to product stewardship, the forms it takes, why it is adopted and how it may lead to benefits to the firm and its impact on the natural environment. The following synopsis outlines the main arguments.

The existence of firms is explained from a number of perspectives. TCE describes firms as hierarchies developed to control for opportunism between transacting individuals or groups. Where transactions are subject to high asset specificity, high frequency and high uncertainty, firms are likely to vertically integrate (Williamson 1985). Whereas transactions that involve common goods not specific to a firm, are of low frequency and certainty is high, firms are more likely to procure on spot markets. This theory provides a strong explanation for the existence and boundaries of firms and a rationale for the procurement activities of firms. Alternatively, specialisation theory leading to the resource-based view sees firms as productive entities that are able to compete in markets because they consist of idiosyncratic collection of resources and capabilities creating heterogeneity in performance between firms (Barney 1991; Wernerfelt 1984). These unique sets of firm resources explains the differences in firm performance. Both these perspectives have been criticised and contain limitations in their ability to explain the behaviour of firms (Ghoshal and Moran 1996; Hill 1990; Priem and Butler 2001a, 2001b). Other perspectives provide alternative explanations of firm existence and behaviours such as the behaviourist school of thought whereby the firm is seen as a decision-making entity (Cyert and March 1963). Firms also exist within a wider external environment that contains resources that firms need and also control mechanisms that affect what firms can and cannot do (Lawrence and Lorsch 1967; Pfeffer and Salancik 1978). Given that firms exist within a wider environment and normally have to transact to exchange goods and services, firms develop relationships with a variety of entities outside of the firm boundary.

Relationships that develop between firms can vary in a number of ways. Relationships can be formed at a variety of different levels with varying degrees of governance formality, ranging from joint ventures, technology alliances to the procurement of goods and services (Oliver 1990). Relationships also vary according to the degree of collaboration. Some relationships are short-term and rely on simple price calculations for example the procurement of consumable goods. Other relationships are longer term, involve high value transactions, are subject to high degrees of uncertainty and lead to dependencies between firms at either end of a relationship (Cousins 2002; Cox 1997; Goffin et al. 2006; Kraljic 1983; Lamming 1993; Sako 1992). How these relationships are dealt with can have an impact on the performance of firms. These impacts are normally in the form of financial and operational performance and the ability to manage relationships which are more collaborative can bring benefits to a firm that it would not achieve individually (Dyer 1996; Dyer and Singh 1998; Dyer and Chu 2003; Ellram and

Hendrick 1995; Ellram 1995; Handfield and Ragatz 1999; Hardy et al. 2003; Jap 2001). Conversely collaborative relationships can be problematic where transactions costs are high due to increased risks of opportunism by partners (Williamson 1985).

Firms also become involved in collaboration in order to share and create knowledge in its various forms and to innovate in areas such as technology (Dyer and Nobeoka 2000; Lavie 2006b; Sako 1994; Zaheer and Bell 2005). Collaborative forms can also be described as networks but the utility of this view can be seen as limited. Similarly, firms engage with a broader set of stakeholders, some with non-economic goals, which relates back to the concept of legitimacy where firms seek to satisfy the expectation of stakeholders in order to maintain social legitimacy (Freeman 1984; Post et al. 2002). Again the value of this view is limited empirically, and theoretical linkages or overlap occurs with previously discussed views such as TCE (Cornell and Shapiro 1987; Donaldson and Preston 1995).

Firms perceive external and internal pressures to respond to ecological issues where responses include product stewardship (Bansal and Roth 2000). Product stewardship can take many forms whereby the harmful impacts of products are reduced at all stages of a product's life (Dutton 1998). Actions can take place at the design stage through DfE, manufacturing stage through pollution prevention and green supply, the use phase again through design or marketing practices and at the end of life by product take-back and recycling systems. Pressures to implement product stewardship originate from the external environment by way of the need to gain legitimacy and competitiveness (Bansal and Roth 2000). If firms do not respond to these pressures they are proposed to lose social legitimacy and reduce competitiveness in the market. Legitimacy can be gained by complying with legislation, satisfying stakeholders, conforming to social norms, however the costs of gaining legitimacy not out-weigh the benefits (Post et al. 2002; Prakash 1999). Competitiveness can be secured through lower costs and increase revenues by tackling operations and products that harm the natural environment, yet the evidence for this is weak (Porter and van der Linde 1995; Reinhardt 1999; Walley and Whitehead 1994). Furthermore firms are subject to internal pressures derived from individuals who maintain environmental responsibility beliefs and can implement discretionary actions (Prakash 2001). To account for these diverging views, some researchers suggest a combination of arguments accounting for competitiveness and legitimacy (Bansal 2005).

For firms to implement product stewardship as a strategy and follow through to operations, the view that benefits should accrue to firms is part of the decision making process. However the ability to gain benefits, especially competitive advantage is proposed to depend on the presence or development of firm specific capabilities that utilise firm specific resources (Hart 1995; Sharma and Vredenburg 1998). Benefits also vary in nature from purely competitiveness related benefits such as cost reduction of production processes, to social legitimacy benefits such as enhanced reputation. This view has been tested by a number of studies, and yet gaps in knowledge about the nature of these capabilities and how they are developed still exist, specifically for the concept of product stewardship (Christmann 2000; Hart and Ahuja 1996; Russo and Fouts 1997). Furthermore research linking these capabilities for product stewardship to organisational benefits is still in the early stages.

Research has provided the theoretical and empirical underpinnings of capabilities for product stewardship in the areas of manufacturing, supply management, however so far only conceptual proposals have provided theoretical background to other aspects of product stewardship such as product distribution and product disposal stages of the life cycle.

The role of collaboration in product stewardship activities has remained a marginal issue in most studies of product stewardship with the exception of the Bowen et al (2001) green supply study and the Carter and Ellram (1998) reverse logistics conceptual paper. Hart alludes to collaboration in his definition of stakeholder integration, although this concept is problematic from a theoretical perspective. Sharma and Vredenburg (1998) refer to 'partnerships' but neither provide empirical evidence to show how 'partnership' or collaborative relationships can lead to organisational or ecological benefits from product stewardship. Conceptual development has also been carried out to explain the types of governance structure likely to occur between firms specifically in the area of end-of-life product recovery based on the TCE rationale (Toffel 2002). This lack of literature is surprising given the amount of material related to collaboration in operations, supply and strategy.

Research opportunities are apparent in the theoretical linkages between the different product stewardship activities, the modes of collaboration, the utilisation and development of capabilities and the link to organisational and ecological benefits. In particular, governance types between market and hierarchies in the area of end-of-life product recovery are neither adequately described theoretically nor empirically tested and are not linked to benefits through the use and development of capabilities. The following section attempts to bring these linkages into a conceptual framework.

4.3 Collaborative relationships and product stewardship: A conceptual framework

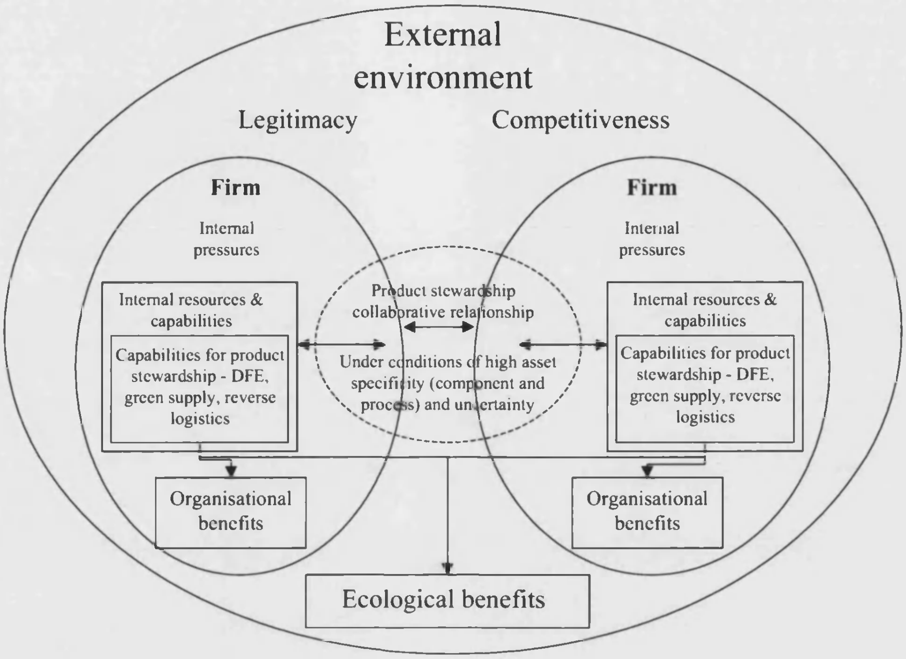

Figure 4-1 A conceptual framework of collaborative relationships and product stewardship

This conceptual framework adopts a similar visual representation as that developed by the IMP group in that firms, and the relationships between firms, exist within an external environment. The framework also characterises firms as containing internal resources and capabilities. The relationship is seen as a linking element between firms and between firms' capabilities. Capabilities for product stewardship are represented as a sub-set of the firm's overall resources and capabilities. The linkages between these concepts is shown by the arrows and explained next.

The framework can be explained by using a number of statements explaining the relationships between the concepts, hence from this discussion the key theoretical gaps emerge. The following argument builds on the literature review, explaining the relationships in the conceptual framework and identifying gaps where current theory does not provide sufficient explanation.

1. Firms are motivated partially by external pressures to undertake product stewardship

The definition of product stewardship adopted here is to *"minimise a product's harmful effects on the environment at every stage of its useful life from concept, design, manufacturing, distribution, usage and disposal" (Dutton 1998 p.59).*

This definition is flexible enough to include the various stages of a product's life.

The first element of the framework is that firms and the relationships they develop sit within the external environment, which is a source of pressures to undertake product stewardship in its various forms. Previous research in this area provides examples of both external pressures for firms to respond to ecological issues as well as internal ones, such as the beliefs of individuals within firms. The external environment also affects the relationships developed between firms, specifically legislation or the threat of legislation, and results in new relationships being developed specifically for product stewardship.

2. Firms are a source of internal capabilities for product stewardship

Researchers such as Hart (1995) argue that firms also comprise of resources and capabilities making use of these resources. Capabilities for product stewardship have been described as stakeholder integration, shared vision, product based green supply, process based green supply, pollution prevention (Bowen et al. 2001b; Hart 1995). While research has explored the capabilities affecting the manufacturing phases of product stewardship including green supply capabilities, empirical work in the distribution phase and end-of-life phase is scarce (Bowen et al. 2001b; Gavaghan et al. 1998; Hart and Ahuja 1996; Klassen and McLaughlin 1996; Klassen and Whybark 2000; Klassen 2001). Conceptual work by Carter and Ellram (Carter and Ellram 1998) discusses factors that lead to the implementation of successful reverse logistics. These are proposed as quality of inputs, vertical integration of suppliers under conditions of uncertainty, policy entrepreneurs, top management support, stakeholder commitment and an incentive system, and yet how these factors can be conceptualised as capabilities has not followed in the literature.

3. Relationships are developed in response to requirements for product stewardship.

Firms, such as product manufacturers, develop relationships with other firms, for example suppliers or recyclers, in order to respond to requirements for producer responsibility in product stewardship (Bowen et al. 2001a; Gavaghan et al. 1998; Green et al. 1998; Thierry et al. 1995; Toffel 2002, 2003). A number of types of relationships have been described in the literature for example the green supply relationships described by Bowen et al (2001) and the product recovery relationships described by Toffel (2002) and White (2003).

4. Collaborative relationships lead to the utilisation and the development of capabilities for product stewardship

For the purposes of this research the following definition of collaboration is used

> *"the process by which partners adopt a high level of purposeful cooperation to maintain a trading relationship over time" (Spekman 1998: 77)*

This is a succinct definition that views the relationship as a process, includes a time element and is flexible enough to include levels of cooperation. Collaborative relationships or hybrid governance structures (between markets and hierarchies) can lead to firm and relationship specific investments, and the development of capabilities (Dyer and Singh 1998; Jap 2001).

GAP 1: The development of capabilities specific to product stewardship may be developed from collaborative relationships specific to product stewardship. To date the types of capabilities have not been derived from empirical studies of product stewardship, with the exception of limited studies on green supply and pollution prevention. Are these capabilities the result of resource acquisition or are they developed specifically for the relationship? For example, Bowen et al (2001) demonstrated that there was a link between supply management capabilities and product-based green supply. However capabilities for reducing the impact of products at the disposal stage are not thus far, theoretically grounded. Furthermore as Angell and Klassen (1999: 582) point out research connecting collaboration and ecological activities is scarce stating

> *"research is needed to identify contexts where each of the structural options (i.e., vertical integration, partnering or outsourcing) offers long-term competitive advantage".*

As Dyer and Singh (1998) argue, and Jap (2001) confirms, specific assets or bilateral idiosyncratic investments can provide the means for competitive advantage. Toffel (2002) describes specific assets for product recovery as valued components or product specific recovery processes, these may be the means by which benefits (rents) can accrue from reverse logistics and product recovery. As Mahoney (2001) points out the market frictions are the very frictions that provide idiosyncratic resources, the source of value in the RBV. Thus the RBV provides an important theoretical lens through which the utilisation and the development of capabilities for product stewardship can be explained.

Hence a gap remains in the explanation of how capabilities for product stewardship are acquired and developed, and the role of collaborative relationships in this process. This is particularly the case in end-of-life product recovery, where product manufacturers are being required to take responsibility for this phase of their product's life and there is a paucity of empirical evidence.

5. Capabilities utilised and developed within collaborative relationships provide benefits to individual firms engaged in the relationship and ecological benefits to the wider natural environment.

Gap 2: The development of product stewardship capabilities may lead to organisational benefits for firms and ecological benefits in the external environment. Some studies have examined the link between environmental performance and financial performance but a positive link has not been convincingly demonstrated (Christmann 2000; Russo and Fouts 1997). Sharma and Vredenburg (1998) produced evidence that capabilities developed from environmental strategies, and that these accounted for competitive advantage (albeit self-reported). Previous studies have not taken an interorganisational view and shown where and how organisational benefits accrue? Specifically Prahinski and Kocabasoglu (2006) state that there is a gap in reverse supply chain knowledge on how working with channel partners reduces uncertainty in its various forms. In addition to this there has also been a call for using forward supply chain concepts in problems involving reverse supply chain (Corbett and Savaskan 2003), where collaboration is an established concept in forward supply chain thinking. Similarly, what are the ecological benefits and where do they reside? How does each capability developed if more than one, relate to specific types of benefit e.g. cost reduction, improved reputation, risk reduction. For example, how does shared vision lead to an organisational benefit? If stakeholder integration is developed how does this lead to benefits, increased legitimacy, thus lower compliance costs?

4.4 Research Questions

The explanation of the conceptual framework has provided the identification of gaps in the theory relating to collaboration and product stewardship. Hence the following research question can be posited.

Research question:

> *How do collaborative relationships between firms, formed due to ecological pressures for producer responsibility in end-of-life product stewardship, provide capabilities that lead to organisational and ecological benefits?*

This research question contains within it a number of concepts and a number of linkages between concepts as shown in the conceptual framework. In order to construct a researchable study area, the question can be further subdivided into core questions that need to be asked before the overall question can be answered. These sub-questions equally represent gaps in the theory in this area described earlier.

4.4.1 Sub-questions:

The research question developed here can be further specified by reformulating the discussion of the conceptual framework into specific questions. The literature shows that firms can modify the relationships that already exist to account for product stewardship goals, such as relationships with suppliers to account for the ecological effects of products bought into firms (Bowen et al. 2001a, 2001b; Carter et al. 1998; Gavaghan et al. 1998; Green et al. 1996). Alternatively firms can establish new relationships with firms that they have not previously been involved with in the past, as described in the literature on end-of-life product recovery or reverse logistics (Roy and Whelan 1992; Thierry et al. 1995; Toffel 2002). This leads to the following sub-question.

1. *What form do relationships for end of life product recovery take and to what extent are they collaborative?*

The second sub-question that can be developed from the literature relates to the capabilities required for product stewardship. While Hart (1995) proposes stakeholder integration and DFE as capabilities for product stewardship in general, this does not account for the differing approaches taken for product stewardship in relation to the different phases of the product's life. While Hart and Ahuja (1996) suggest the manufacturing phase relies on pollution prevention capabilities and Bowen et al (2001) propose the reduction of the impacts of bought-in materials relies on green product supply capabilities, other phases such as product recovery to reduce disposal impacts have not been associated with specific capabilities. Although factors that affect reverse logistics success are proposed, these have been neither empirically tested nor specified as capabilities (Carter and Ellram 1998). Thus the following question emerges.

2. *What are the capabilities needed for product stewardship in the area of product recovery and reverse logistics?*

Merging the implications of the relationship literature and resource-based and capability literature suggests that specific types of relationships can lead to the acquisition and/or development of competitively valuable resources and the capabilities to utilise these resources. It is the more collaborative relationships between firms that involve bilateral idiosyncratic investments that appear to provide benefits specific to the relationship. The extent to which the capabilities required to implement product stewardship, specifically in the area of product recovery has not previously been described nor empirically researched, hence leading to the following question.

3. *Do product stewardship capabilities develop from collaborative relationships and if so how do they develop?*

The final question links two fundamental questions of the management literature. Do collaborative relationships provide organisational benefits (that out-weight the costs of the relationship) and do ecological responses, such as product stewardship in the area of product recovery provide organisational benefits as well as ecological benefits? Furthermore if this is the case for both areas how does this come about?

4. *How do capabilities developed from collaborative relationships for product stewardship, in the area of end-of-life product recovery, provide organisational and ecological benefits?*

4.5 Conclusions

In conclusion, the literature review has identified a number of theoretical linkages between collaborative relationships and product stewardship. Specifically these relate to the proposed acquisition and development of capabilities for product stewardship. How these capabilities develop from collaborative relationships is suggested to be due to the investment in specific assets, but what these assets are with regard to product stewardship is underspecified. Equally the link between these capabilities and how they lead to organisational and ecological benefits is also underspecified. Thus a research question is proposed to set the stage for researching this problem area. The question is given added precision by using four sub-questions to explain the relationships between concepts of collaboration, product stewardship, capabilities and organisational and ecological benefits, deemed relevant to this study.

The next chapter focuses on the methodological challenges to asking the questions developed in this chapter. First, the methodological approach that is appropriate to these questions is discussed. Second, the research design is developed to provide a framework to asking these questions and analysing the answers. Third, the specific method is detailed with a further breakdown of the questions into researchable units appropriate to both the methodological approach, the theoretical contribution and actual the phenomena studied.

Chapter 5 Method

5.1 Introduction

The aim of this chapter is to introduce issues in social science methodology predominantly from an operations and strategic management perspective. The chapter continues with a review of methods which have been used previously in this research area. This is followed by a proposal of methods to examine the research questions developed in the previous literature review, and formulated in chapter four. The chapter ends with a detailed description of the case study protocol as the main methodological tool for this study.

5.2 Epistemology

A discussion of epistemology is an important starting point for research concerning social phenomena as it is vital to identify the basic assumptions of inquiry in the chosen field. Management is that chosen field, and is a field that can be seen as a sub-discipline of the social sciences relating to organisations. Epistemology is the theory of knowledge, and as such Harre (1972) describes epistemology as the understanding of different types of 'knowing'.

Harre (1972) goes on to state that the types of knowledge can be placed on a scale. At one end of the scale, all that can be known is data collected from the senses, like sight, smell or touch. At the other end of the scale the world is exactly how it is perceived and what we experience is real and, importantly, other people having the same experience of the senses are sensing the same reality and the same concepts.

A basic tenet of epistemology is that knowledge can be about a thing such as a description of an object or substance like water, or about the relationship between things, such as ice is colder than water. Precisely, a description of a thing is a 'material concept' and a description of a relationship is a 'formal concept' (Harre 1972). From these basic ideas, knowledge is used to describe things and the relationships between things (whether we know them directly or not).

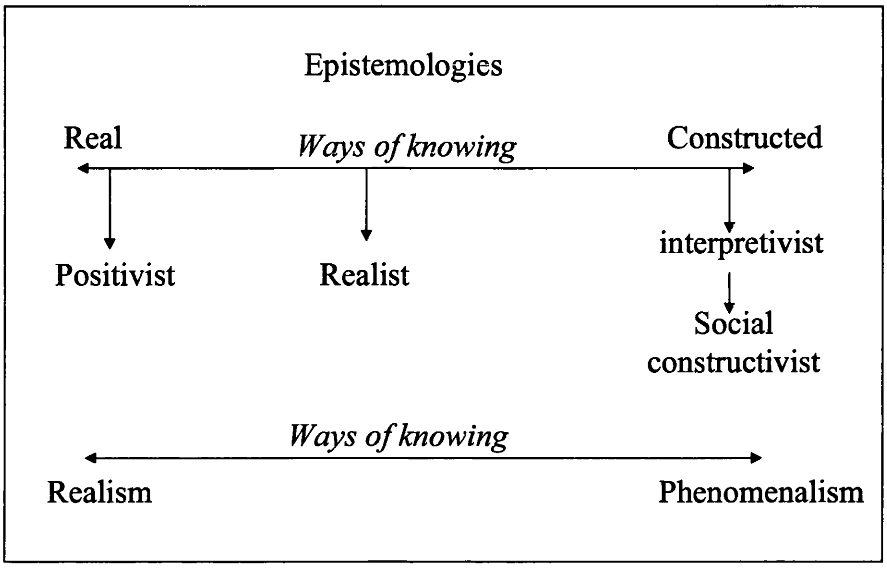

Figure 5-1 The main epistemological perspectives in relation to each other

From figure 5-1 it is possible to see how different viewpoints are placed against a scale of ways of knowing.

The ‘hypothetico-deductive theory’ as advanced by 'positive science' implies that we can deductively infer statements about empirical consequences. For example, these inferred statements may be in the form of hypotheses. The ‘hypothetico-deductive’ perspective suggests that these statements should be tested, however as hypotheses cannot be conclusively verified, Karl Popper's central argument is that the only alternative is falsification. Falsification has also to be viewed in context, by considering that there will always be alternative hypotheses which have not or cannot be tested (Bryman 1989; Ryan 1970).

The dominant idea in scientific explanation of ‘hypothetico-deductive theory’ assumes that this method leads to the development of better theories. However Ryan (1970) argues whether these theories can really be applied to human behaviour? The positive science (also known as positivism) argument follows that if there are regularities and common laws which dictate behaviours through causal relations, given enough processing power we will ultimately be able to predict all behaviour. This deterministic and atomistic view of the world reveals all answers to human problems, eventually, but it is a view questioned by many social scientists (Ryan 1970).

As a reaction to this view a different epistemology has developed. This is because, first, society cannot wait so long for answers to its problems, and second, that society may be qualitatively different to nature as studied by positivist science. From this assumption that society is different to nature, a different epistemology develops, that of interpretivism or hermeneutics. The view here is not primarily of the causes of behaviour, but also of the meaning of behaviour (Sayer 1999).

The methodological perspective in operations management demonstrates a penchant for positivism with the far majority of studies being published using deductive approaches, with Wacker (1998) estimating 81% papers published using this perspective. Research in the US is particularly influenced by this world view and commonly relies on quantitative methods for data collection and analysis. Blackmon et al (2002) show that other regions such as the UK and Scandinavia take a more qualitative view (a collective term covering a more inductive approach including interpretivism and hermeneutics) with the use of case study for instance more prevalent generally. The limitation of the quantitative method common in positivist social science research is that the how and why questions relating to causality cannot be satisfactorily answered (Yin 1993a).

While all perspectives can be viewed as limited to some degree, the literature base of this research study is predominantly from a positivistic viewpoint. Thus the perspective taken here is influenced by positivism, however the nature of the research question requires a more inductive approach as the concepts can be viewed as in a developmental stage and the relationships between these concepts underspecified so far. It can also be argued that a 'grounded theory' approach is not entirely suitable, as a set of a priori concepts have been defined and some relationships tentatively proposed. Thus in this instance the purely inductive approach to analysis of Glaser and Strauss (1967) is unsuitable. It can be argued that an approach is needed that combines the inductive rationalisation but allows the inclusion of predetermined concepts. Coffey and Atkinson (1996) suggest that such a middle approach between the polar extremes of positivistic deduction and the interpretivist induction can be viewed as abductive reasoning. This approach is viewed as appropriate as demonstrated in the following comment by Coffey and Atkinson (1996:156).

"abductive inferences seek to go beyond the data themselves, to locate them in explanatory or interpretive frameworks"

This use of qualitative data to develop explanatory frameworks which are supported by derived relationships from the literature review and a discussion of how methods can link to theory is developed next.

5.3 Linking methods and theory

In order to understand how different methodological approaches link to theory it is first necessary to define theory. A widely accepted view of theory is described by Wacker (1998) as comprising four components: definitions; a domain where a theory applies; a set of relationships between variables and a set of predictions. Wacker provides a procedure for theory building by outlining the key steps involved (shown in Table 6.1).

Table 5-1 Procedure for theory-building (based on Wacker 1998: 368)

Stage	Purpose of this step	Typical questions
Definition of variables	Defines who and what are included and what is specifically excluded in the definition	Who? What?
Limiting the domain	Observes and limits the conditions by when (antecedent event) and where the subsequent event are expected to occur	When? Where?
Relationship building	Logically assembles the reasoning for each relationship for internal consistency	Why? How?
Theory predictions	Gives specific predictions where a theory predicts. Tests model by criteria to give empirical verification for the theory. The riskiness of the test is an important consideration	Could the event occur? Should the event occur? Would the event occur?

It is argued here that the state of theory building in the area of reverse logistics and environmental strategy is still in the relationship building phase of the procedure described in table 6.1. Although theory is further developed in the area of relationships and collaboration, where theory predictions are common (e.g. transaction cost economics theory developed by Williamson), the domain of reverse logistics and environmental strategy is still underspecified from an empirical point of view (as shown later). For example Stuart et al (2002) propose that research into environmental policies is still in the early discovery/description phase or even 'pre-paradigmatic state' as suggested by Angell and Klassen . In fact, Angell and Klassen (1999: 582) point out that for research connecting collaboration and ecological activities

> *"research is needed to identify contexts where each of the structural options (i.e., vertical integration, partnering or outsourcing) offers long-term competitive advantage".*

Wacker (1998) provides further useful advice about the types of methods employed to tackle specific theory-building problems, as applied in operations management. Again these can be summarised using a table (*Table 5-2*).

Table 5-2 The methodological options for theory-building (Wacker 1998)

		Types of research	Refutation methods	Importance to OM theory-building
Analytical (deductive)	**Conceptual**	Futures research scenarios, introspective reflection, hermeneutics, conceptual modelling	Empirical data from empirical methods	Develops new logical relationships for conceptual models of the theory
	Mathematical	Reason/logical theorem proving, normative analytical modelling, descriptive analytical modelling prototyping, physical modelling, lab experiments, mathematical experiments	Empirical data from empirical methods	Explores the mathematical conditions underlying the relationships used in theory building
	Statistical	Mathematical statistical modelling	Empirical data from empirical methods	Integrates the other 5 methods into a single theory for empirical investigation
Empirical (real world and inductive)	**Experimental designs**	Empirical experimental design, descriptive analytical modelling	Analytical/logical inconsistency	Tests and verifies causal relationships between variables
	Statistical sampling	Action research structured and unstructured research, surveying, historical analysis, expert panels	Analytical/logical inconsistency	Tests the theory by investigating statistical relationships to verify their existence in larger populations
	Case studies	Field studies, case studies	Analytical/logical inconsistency	Tests and develops complex relationships between variables to suggest new theory

5.4 Methods in the chosen research area: Strengths and weaknesses

Table 5-3 describes a sample of studies that have employed methods to build theory in reverse logistics, product stewardship and supply chain relationships. The review includes studies from varying fields as operations management, strategy and environmental management literature.

Table 5-3 Methods used in the research domain of collaboration and product stewardship, reverse logistics

Concepts and variables	Authors	Methodological approach based on Wacker	Research design
Product stewardship (PS)			
Ecological response Ecological pressure (Not specifically PS)	Bansal and Roth 2000	Empirical case study	Field interviews with firms across industries
Technology and environmental strategy for product waste	Groenwegen and den Honde 1993	Empirical case study	Single case study at industry level
Corporate Environmental Strategy Environmental capability - stakeholder integration, higher order learning & continuous innovation Organisational benefits (Not specifically PS)	Sharma and Vredenburg 1998	Empirical case study Analytical statistical sampling	Early cases used to develop analytical questionnaire in a single industry
Reverse logistics (RL) as a component of PS			
Strategic and operational factors of RL	Dowlatshahi 2001	Analytical conceptual	Theoretical relationships developed from literature
Outsourcing reverse logistics	Meade and Sarkis 2003	Analytical mathematical	Mathematical decision tool
Successful reverse logistics depends on a number of factors	Carter and Ellram 1998	Analytical conceptual	Theoretical relationships developed from literature
Product recovery strategies	Thierry et al 1995	Empirical case study	Description of strategies using three product level cases
The development and implementation of RL	Stock 1998	Empirical statistical sampling	Survey of US CLM members
Product recovery strategies - outsource or integrate	Toffel 2002	Analytical conceptual	Theoretical relationships developed from literature
Supply chain relationships as component of PS and relating to collaboration			
Supply capability Green supply capability	Bowen et al 2001	Mathematical statistical modelling	Statistical survey
Dep Var: Environmental purchasing Ind var: goals, training, evaluation	Carter, Ellram & Ready 1998	Mathematical statistical modelling	Statistical survey - cross industry with US/German comparison
Environmental management practices and performance Role of suppliers in innovations	Geffen and Rothenburg 2000	Empirical case study	Three cases in one industry, interviews with customers and suppliers

Green purchasing strategies	Min and Galle 1997	Analytical Mathematical statistical modelling	Statistical survey, cross industry
Reverse logistics, information support and relationship commitment	Daugherty et al 2002 (asset recovery not EOL)	Analytical Mathematical statistical modelling	Statistical survey of one industry, catalogue sales cos (n=71)
Coordination efforts, Idiosyncratic investments, opportunism suspicions, goal congruence, interpersonal trust Realised competitive advantages	Jap 1999	Analytical Mathematical statistical modelling	Statistical survey, 4 companies' supplier relationships over 200 dyads sampled
Characteristics of supply partnerships: futuristic orientation, win-win/risk sharing, computer linkages, corp. comms, info sharing, operations information	Carter and Hendrick 1995	Analytical Mathematical statistical modelling	Statistical survey, using 80 matched dyads
Environmental purchasing Vertical coordination, supply uncertainty, competitive sector, input sector, regulatory sector, output sector, quality, resource dependence	Carter and Carter 1998	Analytical Mathematical statistical modelling	Sample of 437 consumer product firms
Knowledge-sharing in supplier networks. Knowledge sharing processes, network-level learning	Dyer and Nobeoka 2000	Empirical case study	Single case including manufacturers (30 interviews) and suppliers (21 interviews), plus survey (n=86)
Trust, length of relationship, face-face communication, continuity of relationship, assistance to supplier, customer stock ownership	Dyer and Chu 2000	Field studies, not specifically case study	Statistical survey, 100 interviews to develop questionnaire, sample of 453 in three countries but one industry
Integration of suppliers in the NPD process	Handfield and Ragatz	Analytical Mathematical statistical modelling	Statistical survey, cross industry/country - 134 companies
Networks	Harland 1996	Empirical case study	Field interviews
Motivations, enablers and inhibitors to obligational contracting, trust in exchanges	Cousins and Crone 2003	Field studies, not specifically case study	Field interviews, matched dyads, plus some statistical analysis
Supply chain structure	Choi and Hong	Empirical case study	Descriptive of network structure using 31 semi-structured interview
Effects of IO collaboration: strategic effects, knowledge creation and political effects.	Hardy, Phillips & Lawrence 2003	Empirical case study	Eight collaborations by one organisation (not for profit)

From the review presented in table 5-3 a number of points can be made about the methodological approaches taken in studies of the concepts of relevance to this thesis. While this is not an exhaustive list of the studies in these areas, they indicate the main approaches taken.

The first point to make is that no single study has examined the role of collaborative relationships in the end of life product recovery/reverse logistics domain. The closest studies to this thesis relate to environmental purchasing or green supply. For example

Geffen and Rothenburg (2000) suggest the need to have close relationships for environmental innovation by utilising a three case study design in one industry. Carter and Carter (1998) show that vertical co-ordination is related to the level of environmental purchasing activities i.e. that vertical co-ordination should facilitate the rate of adoption of new technologies and processes. They suggest that closer relationships allow supplier involvement in design of products for disassembly, re-use and recycling as well as waste reduction. For these statements Carter and Carter use mathematical statistical sampling approach of consumer product firms. In the domain of reverse logistics, but importantly, not end of life products, Daugherty et al 1998 show that relationship commitment is important in moderating the effect of information support on reverse logistics financial performance. The link was not found to be significant.

Table 5-3 shows that in general product stewardship as a concept is limited to descriptive cases and not used as a construct in empirical studies, compared with constructs such as corporate environmental strategy or environmental purchasing for example. Equally, reverse logistics and end of life product recovery are predominantly in the analytical conceptual phase, being used in empirical cases. Although broader survey work has been carried out these studies either focus on one industry with no reference to end of life product recovery or provide limited theoretical contribution (Daugherty et al. 2002; Stock 1998).

The use of analytical mathematical statistical modelling for supply chain relationships and collaboration is more prevalent than in the other areas of table 5-3. This appears to reflect the maturity of the theory in this area where constructs and variables have been developed and tested. As Wacker (1998) states this approach "integrates the other 5 methods into a single theory for empirical investigation". There is little or no application of this approach in the reverse logistics EOL product recovery domain. Overall this review reflects the positivist outlook in the main body of studies, although some studies such as that carried out by Hardy, Phillips and Lawrence (2003) are more interpretivist in nature.

5.5 Research Design

The review of the literature in this area shows that a variety of methods have been used although techniques such as experimental designs and participant observation have not been common. Many of the studies which have had the largest theoretical impact are those which have employed a variety of methods in order to bring a broader inclusion of data to support argument.

Both experimental designs and participant observation could shed new light on the issue which is still developing. Against this however are both the nature of the questions posed and the practicalities of the research process. An experimental method is deemed as unsuitable as the unit of analysis is the product at industry level and firm level capability for collaboration involved interfirm interactions which would be problematic to control for experimental purposes. An ethnographic study using participant or non-participant observation may be another alternative. These techniques require the immersion of the observer in the phenomena being studied and although this could allow in-depth analysis of behaviour through intensive field experience, a broader level analysis may be limited and comparison of firms within and between sectors may be difficult.

Discussion of the unit and level of analysis should provide further guidance towards an appropriate design for the research. It is proposed that the unit of analysis should both relate to the product at the industry level and the relationships between firms. This is because the product is the focal point of product stewardship activities such as recycling and reverse logistics. Furthermore, the relationship level allows the consideration of the implications of relationship characteristics at a firm level, capabilities developed at relationship level and benefits accruing at the relationship level (incorporating the relational view posited by Dyer and Singh 1998), and more generally such as the effect on ecological benefits that are not necessarily at a firm level. Therefore, to compare differences in recycling and reverse logistics activities it is convenient to compare those across different product types as the influence of external and internal factors may be different and relationship types again highlighting differences and similarities.

The proposed level of analysis is both the firm and inter-firm activities and attributes such as information sharing, joint decision-making and shared planning activities, assets of firms, capabilities of firms, capabilities developed within relationships and the outcomes of relationships e.g. the benefits at the organisational level and ecologically. In order to facilitate this, the unit of analysis must be capable of capturing evidence from these levels.

The following table outlines the design and the rationale for the research design (table 6.4)

Table 5-4 An outline of the research design

Aspect of design	Description	Rationale
Type of research	Empirical case study	Most of the research relating to reverse logistics as focused on conceptual analysis and development, thus cases, as stated by Wacker 1998 "Tests and develops complex relationships between variables to suggest new theory".
Refutation method	Induction and analysis of logical inconsistency	A conceptual framework has been developed, but the linkages between concepts need to be defined through an inductive approach from the data
Level of analysis	The firm and the relationship	To understand outcomes at a firm and relationship level
Unit of analysis	The product and the relationship	To compare across product industry types and across industry types
Number of cases	Three	To compare across different products and firms
Type of cases	Nested cases of dyads	To compare different firms, relationships between firms and control for product industry by including more than one dyad per product

The table outlines the rationale for the overall approach to be taken in this study. However, further examination of the literature is required before a detailed design of the case can be described. A review of case study methods follows next.

5.5.1 The design of the case studies

It is proposed that this study follows with case study as the primary mode of inquiry. As stated earlier case study approaches tend to be more suited to new research areas or where adequate theory appears to be lacking in some way (Yin 1993a). Also case study work is effective for building theory as, given the right methods, causal relationships can begin to be visible (Eisenhardt 1989). In this case an explanatory approach would be best suited as this allows explanation of the how and why questions which are central to the research questions developed in Chapter Four. The following table provides a map from the research questions, through sub-questions to the operationalised questions.

Table 5-5 Map linking research questions to data collection questions

Research Question	Sub-questions	Operationalised questions
Industry context and external environment		How do ecological issues impact on the organisation and the industry in general? Are there other stakeholders indirectly involved in the scheme such as local authorities, central government or consumer groups?
How do collaborative relationships between firms and their stakeholders, formed due to ecological pressures for producer responsibility, provide capabilities that lead to organisational and ecological benefits?	What relationships exist and which are developed for end-of-life product recovery? What form do these relationships take and to what extent are they collaborative?	How is the product collection and recycling system organised/structured and who is involved? Are there other stakeholders indirectly involved in the scheme such as local authorities, central government or consumer groups? What types of relationships exist between the organisations in the system?
		What types of transactions are made between organisations, in terms of exchanges of goods, services or information? Describe the type of relationship that exists between the OEM-recycler or recycler-OEM?
	What are the capabilities needed for product stewardship in the area of product recovery and reverse logistics?	Describe the activities, skills and technologies involved in end-of-life product recycling and their development? What are the capabilities needed to achieve the requirements, do they fit the definition of capability? Are the resources used competitively valuable (rare, socially complex, inimitable) and do they allow external social legitimacy?
	Do product stewardship capabilities develop from collaborative relationships and if so how do they develop?	Which resources does your 'partner' hold that allow the achievement of benefits? Which resources, that are specific to the relationship, allow the achievement of benefits? Give examples or demonstrate how the resources associated with the relationship provide organisational and ecological benefits
	How do capabilities developed from collaborative relationships for product stewardship provide organisational and ecological benefits?	What are the organisational and ecological requirements (legal/policy) and benefits of product recycling? How do the skills, technologies and assets of this relationship allow the achievement of the organisational and ecological benefits?

5.5.2 Case study techniques

Yin (1993b) gives six possible sources of evidence for case studies: documentation, archival methods, interviews, direct observation, participant-observation and physical artefacts. It is intended to use interviews as the main source of information on the influence of the collaborative capability concepts on product recycling. Silverman (1993) states that there are some problems with direct interviews however, such as response bias, poor recall inaccuracies and replying to questions in manner that the respondent thinks the interviewer wants to hear. In order to verify case data and overcome these problems, techniques such as the use of documentation and archival searches can be precise and help overcome interview limitations. Direct observation of activities to verify interview evidence as being real and allowing the understanding of context, can act as another source of data on the variables in the research. As Yin (1993b) argues, using multiple sources of evidence is an important defence against threats to construct validity.

Case study protocol. Much research using case studies utilises a protocol to ensure consistency and reliability in case data collection. The aim of the protocol is to set the framework for carrying out the case study, delineating who is to be interviewed or observed, what is included in the case and when these activities are to be carried out. This is an important part of providing reliability in the research processes especially when multiple views are being sought (Yin 1993b).

Interviews

Arksey and Knight (1999) state that a key advantage of interviews is to find out what cannot be directly observed. Through interviews it is possible to explore the meaning of behaviour and routines and gain clarification. It is also possible to examine the context of phenomena. Other positive points include the possibility of oral history, the recounting of past events, 'albeit' as the respondent perceives them (Arksey and Knight 1999).

There can be a number of approaches to interviewing. As examples, more than one interviewer or interviewee can be used. It is possible to interview social groupings to understand group dynamics, although problems can arise due to political tensions, where in some cases responses may be held back by vulnerable parties (Arksey and Knight 1999).

Yin (1993b) purports that the structured interview adheres strictly to a schedule, so that reliability in the research process is maintained and that methodological differences across many interviews is minimised. This tends to be a more positivist approach to interview work which can be akin to a survey, but with built-in flexibility for clarification of questions and further explanation. It is proposed for this research that the previous development of concepts and variables will allow a schedule to be created and would aid reliability in the research process.

The types of questions included in the interview schedule or guide can also vary between open-ended questions often associated with unstructured interviews and closed questions related to structured interviews. In general for the structured or semi-structured approach it is advised that leading questions, 'double-barrel' questions and hypothetical questions are all avoided. It can help the process if the interview starts with easy to answer questions in the form of ice-breakers.

Arksey and Knight (1999) suggest a number of further points. As a general guide it is important to achieve and maintain trust in the interview. In the opening stages, remarking on previous successful interviews can aid a smooth start. Eye contact and avoiding a sense of urgency can also help during the process. In closing the interview an explanation of next steps and stating how helpful the interview was are important. Writing a letter of thanks will additionally support the respondent's positive experience of the process, especially if continued contact is required.

Direct observation techniques can form a second source of evidence in case studies. Methodological guidance of observation is again predominantly interpretative in nature and centres round ethnographic approaches (Van Maanen 1983). For example, the Gersick (1988) study undertook to observe every meeting of every team using audio tapes and producing hand-written transcripts to back this up. The observational notes included the enthusiasm of individuals, devices used and routines observed. This open style was considered appropriate for an inductive discourse analysis and the level of 'brain storming' teams.

Two further methodological issues arise from this data collection technique. Firstly, a decision must be made about whether the researcher is a participant or a non-participant (Spradley 1980). It could be argued that it does not matter which as long as this is noted and appropriately accounted for in the case analysis. One approach for this research could be the researcher as an 'observer-as-participant' resulting in casual, but non-directive interaction (Angrosino and Mays de Perez 1994).

The second issue is confidentiality. As the researcher may be within the organisations studied, through site visits for example, and present when potentially sensitive material is being discussed, the firms and individuals must be confident that the data collected will not be used unethically or in a way that compromises their competitiveness. In this case the researcher may need to sign a confidentiality agreement. Overall this technique is useful for prolonged engagement, and a powerful tool for triangulation, but may require a debriefing of those observed or at least checking of the broad research outcomes (Sanger 1996), if only for ethical reasons (Punch 1986).

5.5.3 Qualitative analysis

The first stage of analysis is normally the organisation of the data into common formats. The transcripts from interviews and observation sessions are produced ideally within 24 hours of the data collection in order to ensure that data is accurately recorded and time does not adversely affect recall of events. Where possible the interviews and observation sessions should be recorded to ensure accuracy. These transcripts can be prepared in word file documents and layed out exactly according to the sequence of events and interview schedule. These transcripts are then ready for analysis through ordering and coding.

Coding is the identification of key themes and patterns to organise, manage and retrieve the data needed (Coffey and Atkinson 1996). It can be described as tags and labels of units of meaning attached to chunks of words or sentences (Miles and Huberman 1994). It is also seen as the process of data reduction and simplification, but can expand, transform and reconceptualise. Coding often follows three main stages to interpretation. First is the ability to retrieve data in meaningful quantities which can be put into displays (such as matrices) and compared with other meaningful parts. Second, the codes and categories can be explored to find relationships between them. Lastly, meaningful information is produced by emphasising positive and negative points, those that support previous theory or not, and testing hypotheses drawn from theory or other cases.

Computer-based tools can greatly help the analysis process through efficient handling of data. This is primarily through the use of databases. These text-based data managers allow information of any length to be stored. There are also code and retrieval programs where notes can be attached to particular texts (Popping 2000). The most powerful of these qualitative text analysis tools are the 'theory builders' such as NUD*IST which performs hierarchical ordering. The most recent version of this, NVivo, allows text to be included straight into the programme and can use other forms of documentation in the linking and coding process (Richards 1999). Dainty et al (2000) claim that computer aided analysis can enhance qualitative research through the assistance of data management, and the facility to code and retrieve data. They argue that NVivo as a conceptual network builder can help in the conceptual representation of data using networks of nodes and links. A note of caution however is that using a computer based analysis tool could restrict the diversity of approaches to those readily used in the programme (Weaver and Atkinson 1994). Training in use of the programme is proposed to counter this problem.

Observation analysis. One technique advised is the use of matrices to display data while ordering observations along a number of dimensions. For example Spradley suggests dimensions of space, object, act, activity, event, time, actor, goal and feeling. The notes of the observation are organised in this matrix to understand the cultural patterns of the social situation (Spradley 1980). A second approach is to develop domains from the data which include cover terms (such as the type of organisation), included terms (similar types) and the semantic relationship (is the main consumer of a product). These domains would consist of the main constructs of interest in this study and the cover terms, the measures by which these are constructed (based on the literature such as the evidence of ecological benefit). Domains which emerge from the analysis and that are distinct from the those in the literature can then be described with associated cover terms and included in the overall analysis if deemed to be significant to the outcome.

Within-case analysis. The use of causal networks are of particular use in within-case analysis. They are a useful way of obtaining an interpretative explanatory account which is not just partial (Miles and Huberman 1994). This is similar to single site causal networks. An example of a hypothetical network is shown in figure 5-2.

Process Data analysis using process mapping is another techniques for within case analysis. The use of process mapping allows a temporal analysis of the process of development and implementation of a phenomena and so the impact of organisational decisions and actions on the implementation. Also included in this analysis is the impact of all the organisations involved in implementing the strategy, to understand how these interact.

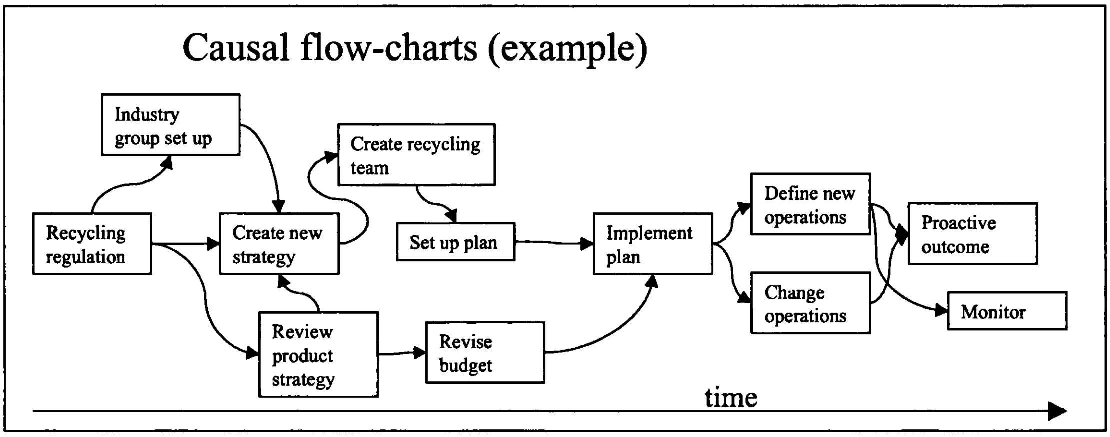

Figure 5-2 A generic example of a causal flow-chart

The important feature of these flow-charts (either termed causal or process) is that they allow the presentation of large amounts of information is a small amount of space, showing precedence, parallel processes and linkages between elements (Langley 1999).

Cross case analysis. Miles and Huberman (1994) suggest the ranking of cases or sites according to indicators of outcomes enables the comparison of the case across the other variables so that patterns may be discerned. This can enable comparisons of whether there are corresponding associations between concepts. The cases can be organised based on the presence and the extent to which these components are present. Using only three cases limits this approach for cross-case analysis, but is a useful technique nevertheless, but the cases can be broken down a level to individual dyads or location (i.e. between manufacturer and reprocessor).

The use of tables can be problematic, as there is a requirement to place attributes into categories or classifications. As such decisions are needed to allocate the unit of analysis. In this case the case study itself (or each dyad of the case study) may be allocated to a rank or level. There may be difficulties to deciding upon a cut-off point between levels and the allocation process may be to a certain extent be arbitrary if the cases are not fully differentiated (Miles and Huberman 1994).

The ranking of the cases can then allow an analysis of the differences between the cases at the top and bottom levels of the ranks along the concepts chosen (both external and internal). This analysis would follow for each of the variables to help explain the differences between them.

These types of associations will help explain what it is that influences the strategy outcome, and which components of variables or whole variables do not. This is also known as iterative tabulation, and searches for explaining why relationships appear to exist help to build internal validity into the findings (Eisenhardt 1989).

To counter the over simplification of comparison it may also be possible to split the outcomes of each case into a number of areas such as the various elements of meeting legislation including meeting environmental standards for sites, acquiring depollution equipment, actually depolluting products or providing take-back. The cases can be compared across each of the elements to provide more sensitivity in the results.

5.5.4 Summary of design issues

The proposal for methods within this research should cover the key elements essential to case studies as detailed by Stake (1994) and these are:

Bounding the cases. The cases comprise of those organisations involved in bringing about the improvement in product stewardship performance in the area of end of life product recovery. The number of cases is limited to three industrial groups of products where a product manufacturer has linkages with a firm to bring about EOL product recovery.

Selecting the phenomena of study. Within the cases the following phenomena will be researched: interorganisational cooperation related to product recovery.

Seeking patterns of behaviour. The cases will explore within case differences, similarities and process flows as well as cross case comparisons to draw out patterns in the phenomena examined.

Triangulation. Both interviews and observational techniques will be employed to gain multiple research perspectives. Secondary data will also include published material on firms and internal documentation. The interviews will also involve multiple parties in the same organisations and across organisations implementing the same strategy in order to validate findings.

Selection of alternative interpretations. The analysis is flexible enough to allow both proposition building based on a priori constructs but also analysis of emergent themes to allow a range of interpretations.

Develop assertions and generalisations. Proposition building enables the further development of both validated propositions for the specific cases but also generalisations for cases outside of the research sample, primarily through cross case analysis of similarities and differences and the analysis of contextual variables such as product type and legislative framework.

In order to guard against threats to validity the following features of the design, case study data collection and case study analysis are incorporated into the study:

Multiple case study. The approach provides a defence against problems of external validity. This also builds construct validity.

Use of case study protocol. A protocol in tandem with an interview schedule will improve reliability in the data collection phases.

Multiple data collection techniques. The combined use of interviews, direct observation of phenomena and secondary sources should enable both external and construct validity to be strengthened.

Mix of qualitative data analysis techniques. The variety of analysis techniques including process flowchart construction and iterative tabulation can improve the degree of internal validity.

5.6 The case study design

5.6.1 Introduction

This section describes the case study design overall and the protocol developed for this research - the standardised method for carrying out the case studies (Yin 1993b). Organisation of the protocol followed four stages: Stage One) Case Selection - Product recycling network mapping, Stage Two) Semi-structured Interviews, Stage Three) Observational and secondary evidence validation and Stage Four) Analysis. Each section in this design details the approach taken, the research questions asked and the actual procedure carried out. This protocol was followed for each of the three cases (as well as a pilot case) to ensure a common approach to the data collection phase which is an important attribute of robust case study work (Ellram 1996; Stuart et al. 2002; Voss et al. 2002).

This case study design is intended to answer the following research question derived from the literature:

How do collaborative relationships between firms, formed due to ecological pressures for end of life producer responsibility, provide capabilities that lead to organisational and ecological benefits?

5.6.2 Key features of this case study method (levels and units of analysis)

The cases were set at industry-level, for analysis purposes and to obtain theoretical insights at this level in the first instance. While the aim was not to explore industry differences per se, taking cases from different industries allowed explanation to extend beyond the idiosyncratic features of specific product industries. The phenomenon being studied - collaboration for product stewardship - against which this study is set, is also applied at industry level e.g. for cars and tyres for the electronic products, mobile phones and photocopiers, which emphasises the relevance of this analysis level.

Within each case, two relationships between organisations were used as a unit of analysis. As the relationship is seen as a process, the actual unit was the dyad (two firms) and this is used to explain the role of collaboration in bringing about organisational and ecological benefits (to both firms). Thus firm level outcomes will also be explained. Furthermore, observation techniques will be used to provide validity in respect to the outcomes of collaboration i.e. the benefits.

5.6.3 The case study boundaries

The first boundary setting criteria is geographic, the UK. As collaboration is the phenomena under study, other variables relating to country differences can be accounted for by focusing on one country. Other antecedent conditions, such as the development of the industry, may also vary from country to country, so this was kept constant for the cases. An exception was Flextronics and Xerox, whereby there was only one UK based relationship and therefore to find another dyad it was necessary to examine the site based in the Netherlands (Venray)[23].

The second boundary limit was those companies actually involved in the collection, take-back and recycling of end-of-life products as defined in the regulation (ELV and WEEE Directives), and specifically putting in place operations to meet these new regulations (which is used here to define the ecological benefits).

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[23] This was not viewed as problematical as the case is primarily driven by European based policies which are the same in the UK and the Netherlands and the recovery operation is planned at a European level, with minor country specific differences.

A third boundary limit is the industry as defined by the products produced. Thus for each case only companies involved in producing and recycling a particular product type, such as a vehicle or photocopier, were used.

A number of collaborative situations or dyads was sought within each case, to provide a degree of 'representativeness'. This method was successfully utilised in the Hardy et al (2003) study examining collaboration effects. Each dyad included a product manufacturer (who held legal responsibility for recovery, or would be implicated in new regulations) and a recycler (who actually carried out the actions of product take-back and recycling).

The process to be followed in the protocol was as follows in Figure 5-3.

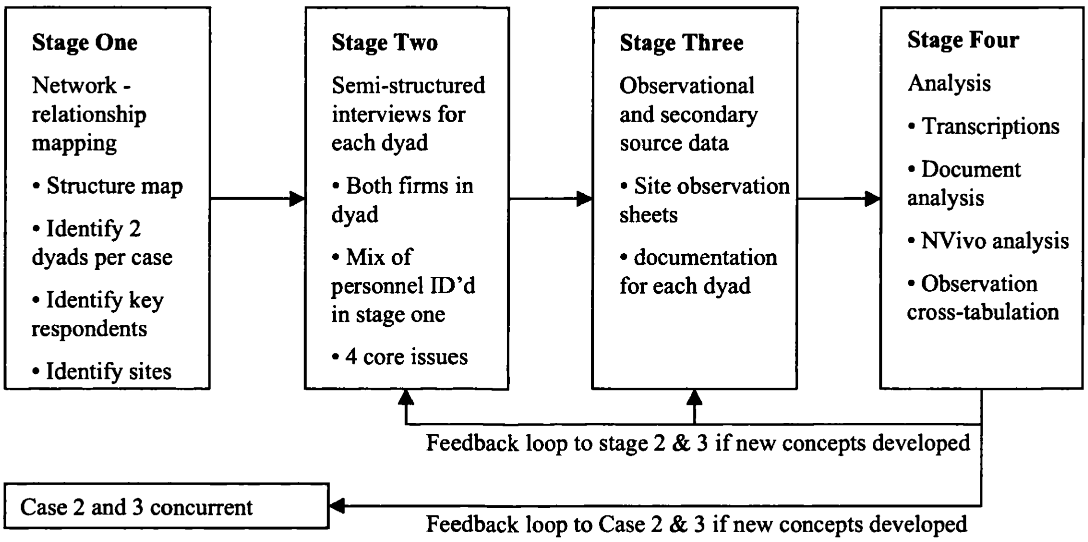


Figure 5-3 Case study protocol process

Organisations and respondents in the case studies: The organisations included those that have implemented or are implementing operations that meet the new requirements of the EU Directives on ELV[24] and WEEE[25]. In order to identify cases that provide some theoretical variance, the first stage of the protocol deals with describing the networks of relationships at a product-industry level, focusing on individual firms and their recycling networks. From this, suitable dyads were selected to provide the basis for the further stages of the protocol examining collaboration, and organisational and ecological benefits.

[24] End of Life Vehicle
[25] Waste Electrical and Electronic Equipment

The reason for choosing automobiles, mobile phones, tyres and photocopiers was that the popular press and industry conferences have shown that they are at the forefront of implementing systems to recover their end-of-life products. This also accounted for industry differences from a business context perspective.

The dyads themselves were selected within each of the three product groups and limited to two due to the need to gain what Choi and Hong (2002: 472) call 'cognitive familiarity with all aspects of the data'. Theoretical sampling was then be used to choose dyads which demonstrated particular attributes as suggested by Meredith (1998). As defined by Strauss and Corbin (1990: 201) theoretical sampling is "data gathering driven by concepts derived from evolving theory and based on the concept of making comparisons". Thus the criteria will include the degree of collaboration (Ellram and Hendrick 1995; Lamming 1993), relationships as part of a consortium and relationships focused on a single OEM (Mayers and France 1999; Toffel 2003), to identify cases that demonstrate theoretical differences. The literature presented no examples of end-of-life product recovery carried out entirely 'in-house', and no examples were found in sources in the public domain.

Previous research by Toffel (2003) showed that it is the producers who have primary responsibility for both meeting economic costs and meeting ecological standards. They have built up relationships with recycling companies who carry out the actual reverse logistics flow and perform transformational activities on end-of-life products (Thierry et al. 1995). Industry associations are also involved in the process of setting standards and liaising with policy-makers (Mayers and France 1999). In relation to the dyads as a unit of analysis, OEMs and recovery firms will be used across all the cases to provide replication.

For the first stage of relationship mapping, the industry associations were also be involved where possible to gain an industry-level perspective of the recycling networks in addition to OEMs to gain specific evidence on relationships for product recycling. In the second stage, examining dyads between OEMs and recyclers, personnel with knowledge of the specific operations and the relationships will be sought. From the OEM side individuals with responsibility for compliance with ELV and WEEE directives, and those involved with 'contract negotiations'. From the recycler side individuals with responsibility for legislative compliance, recycling operations, 'contract negotiation' with the OEM. Figure 5-4 shows the overall case study design with relation to the number of cases, dyads and organisations.

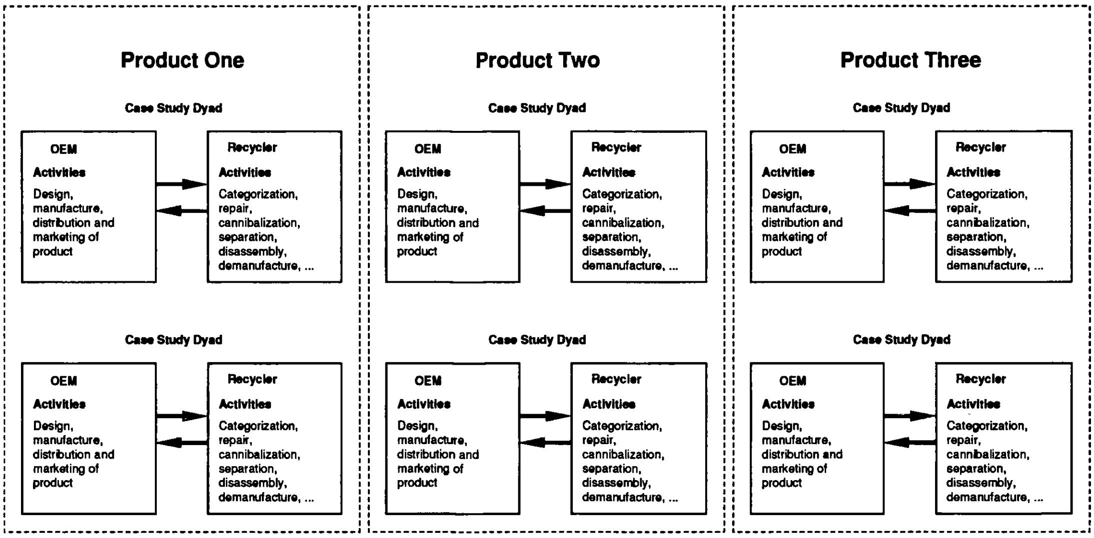


Figure 5-4 The scope of case study design

5.6.4 *Validity and reliability*

The issues of validity and reliability with relation to case studies has been extensively described by Yin (1993a; 1994). The strategies taken to deal with these research design challenges are derived from the Ellram (1996) paper describing case study approaches in logistics research.

To address external validity - how accurately the research represents the 'real-world' - the case study design needs to address the issue of generalisability. For this design the three cases cover more than one industry to explain the phenomena in more than one context. Furthermore each case will contain more than one example of a collaborative relationship between firms, again to add further external validity.

To ensure reliability this protocol will adhere to an objective set of procedures as set out in this protocol. In addition, a database will be developed for each of the cases. The database will be used to structure the collection and storage of data in common formats. These formats will include the copy of the protocol, network mapping diagrams which are annotated, audio tapes of the interviews alongside transcripts of the interviews, completed observation sheets and copies of documentary evidence from the case study firms.

Construct validity will be provided by implementing three strategies which have proved helpful in past studies such as that carried out by Ellram (1996) on the Total Cost of Ownership. The first strategy is to use multiple sources of evidence, in this case multiple informants, interview methods, observation methods and use of documentary evidence. To maintain what Ellram (1996) calls a 'chain of evidence', the logic, flow, clarity and content of case study findings need to be present. The case study findings will be produced in report format for external review to check that this chain of evidence is convincing. The industry informants will be encouraged to check for validity in the findings.

Internal validity is the final issue that needs to be addressed in the design. This is particularly important for explanatory case study work because of the reliance on inference of linkages between concepts. The analysis method is the primary means by which internal validity can be strengthened through the use of different coding methods such as open coding, axial coding and selective coding which will be discussed in the section on analysis. Open coding refers to the initial summarising of the data, whilst axial coding is the process of making connections between the categories developed in the open coding process. Selective coding will allow the testing of different explanations of links between categories or concepts (Miles and Huberman 1994).

The concepts used in this research were described in previous theoretical and empirical studies, providing a priori constructs, and, in some cases, measures that can be used. Thus a grounded theory approach based on pure induction is not required. However the relationships between the concepts which are proposed in the literature are presently untested thus a robust analysis method is needed for linking concepts. This research will employ computer-based tools (NVivo) to test the relationships between the concepts to provide a transparent analysis method, to allow replication in the analysis technique.

5.6.5 Case study procedures

Yin states that a case study should have "*explicit and well-planned procedures*" (1994: 68). The case study protocol will comprise of three data collection procedural stages in order to gain evidence of different types, from multiple sources: 3.1) Product recycling network mapping and case selection 3.2) Semi-structured interviews and 3.3) Observational and secondary source validation. These are described next.

5.6.6 Stage One - Product recycling network-relationship mapping & dyad selection

The purpose of this first procedure is to obtain an overall picture of the end-of-life product recycling schemes in the UK in the target industries and then to establish researchable units of analysis within these schemes by delineating the boundaries and applying the selection criteria. The outcome will be a 'supply network' map in the style of that devised by Choi and Hong in their study of automotive supply chain, but in this case at a product-type level. This stage of the research will be used to select dyads for further in-depth study and identify the individuals with the knowledge of the areas covered in this research (such as environmental managers, operations personnel, purchasing personnel).

Topic: The set of questions which are asked in this area relate to the network of relationships that exist to meet product stewardship requirements. As previously stated, the product manufacturers are mandated to hold economic and ecological responsibility for product recycling. Therefore this will be the starting point for mapping relationships in this area. This section of the protocol will be aimed at personnel with responsibility for implementing end-of-life product recycling in accordance with new regulations (ELV and WEEE Directives).

Summary of questions

Questions	Sources
How is the product collection and recycling system organised/structured and who is involved?	Thierry et al 1995, Toffel 2002
Are there other stakeholders indirectly involved in the scheme such as local authorities, central government or consumer groups?	Hart 1995
What types of relationships exist between the organisations in the system?	(Carter and Carter 1998; Cousins 2002; Dyer and Singh 1998; Ellram and Hendrick 1995; Lamming 1993)
What types of transactions are made between organisations, in terms of exchanges of goods, services or information?	(Carter and Carter 1998; Cousins 2002; Dyer and Singh 1998; Ellram and Hendrick 1995; Lamming 1993)

Detail of the procedure: The network perspective is not the main theoretical standpoint for this research (which takes a natural resource-based view), and therefore social network analysis is not the primary mode of investigation. However, in the first stage of the case study it is important to set the boundary and select sites in a defined manner (Stuart et al. 2002). As Stuart et al (2002) recommend the initial selection of companies will be based on theoretical differences to provide diversity in the cases and based on popular press and industry conferences.

Using techniques devised in network analysis can help produce a common approach to setting a boundary for the cases. Network analysis methods have been used in a number of studies, primarily taking a network perspective (Choi and Hong 2002; Ellis and Mayer 2001; Nohria and Eccles 1992; Pegels and Song 1997; Tichy et al. 1979). From this literature, the methods used for obtaining data on the network characteristics include secondary sources (industry publications), surveys and interviews. In order to understand the role of collaboration - integration of stakeholders and interorganisational cooperation - in providing benefits of product recycling, the network perspective can offer a number of starting points. Firstly, network concepts can be used in order to understand basic properties such as transaction content, the nature of links and structural characteristics (Tichy et al. 1979). Given the nature of key concepts in this study, transaction content relating to exchange of information and exchange of goods or services appears to be a useful starting point.

The method employed by Choi and Hong (2002) produced a useful of depiction of a supply chain in the automotive sector. It is proposed that this method is applicable here and can be used to show the network of relationships at a product manufacturer level. An example of this is shown in Figure 2.

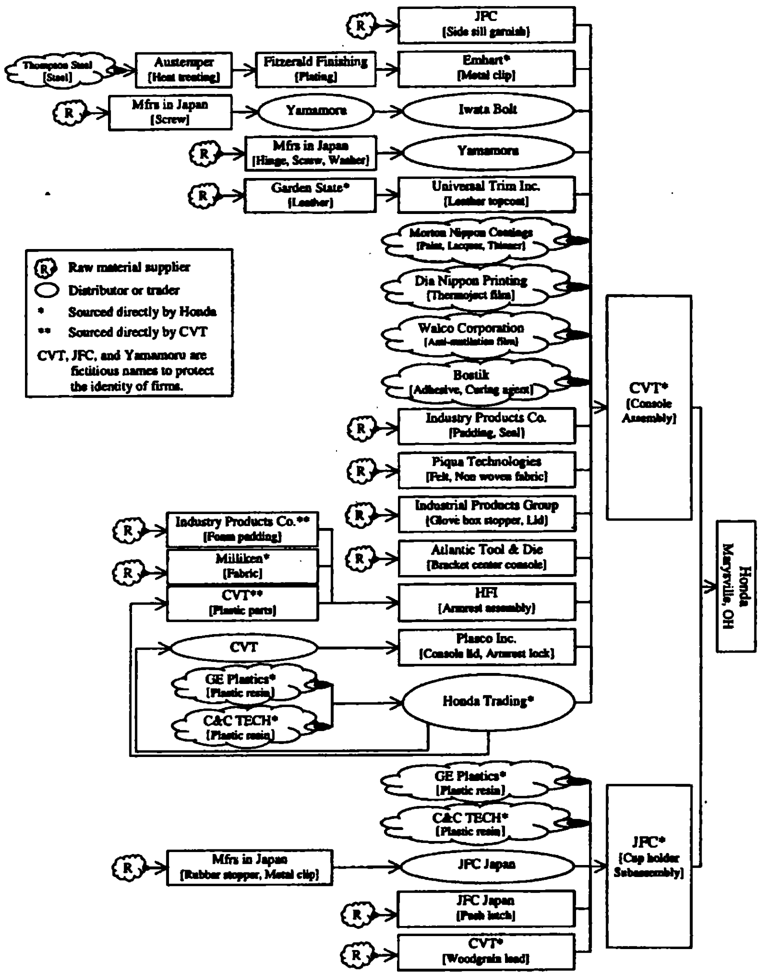


Figure 5-5 A supply network produced by Choi and Hong 2002.

For this part of the protocol an interview-based mapping procedure will be used based on the Choi and Hong (2002) methods. Where possible, this will utilise data collection from more than one informant at a time, a social grouping (Arksey and Knight 1999), preferably across more than one organisation. The linkages between the organisations identified in the mapping procedure will be represented following the conventions developed by Conway and Steward (1998b p.240) relating to the intensity of the interaction (represented by the thickness of the line), the type and formality of the relationship (represented by solid, dashed or dotted lines) and the direction of flow (represented by arrows on the connecting line). The procedure will comprise the following steps.

The first stage was to identify organisations that have started to implement the requirements for the ELV and WEEE Directives. This was done by contacting industry experts particularly from trade bodies and regulators (such as the SMMT). Draw up initial network based on industry and trade publications, press releases, journal articles and other secondary sources.

1. Contact informants and arrange mapping session
2. Questions can be asked based on Choi and Hong the following
3. Who are the 'suppliers' for the end-of-life products? Extend the networks.
4. What are the locations? Major warehouses, depollution, dismantling, demanufacturing facilities?
5. Identify the 'suppliers/recyclers' further downstream. Which components/materials do they deal with?
6. Review case study network-relationship map, with informants and if gaps are apparent repeat process with extra informants until gaps are filled.
7. Ask informants to identify relationships between OEMs and recyclers that could be viewed as collaborative and those that are not (using Lamming's 1993 model as a starting point). Where activities are not outsourced, this could provide further theoretical variation. Identify personnel and sites that could be used to answer questions in the next two sections of this protocol.

The network-mapping session was formalised through a document detailing the main questions asked. This is presented in Appendix One p.291 and was sent to informants beforehand.

5.6.7 Stage Two - Semi-structured Interviews on collaboration and resources

Scope of interviews: The organisations and individuals identified in the network-relationship mapping work will be contacted in order to arrange interviews. The individuals selected will require knowledge about the relationships or transactions that the firm has with organisations upstream and downstream from the focal activities (collection and recycling) and the resources needed to achieve organisational and ecological benefits. This may mean that representatives from different functions need to be interviewed such as those with responsibility for legislative compliance and those responsible for contract negotiations. Individuals from these functions will be interviewed on both sides of individual dyads across all three case studies.

The interviews are designed to capture information in four question areas: 1) contextual issues (ecological pressures and industry issues), 2) product stewardship operations and required resources 3) inter-organisational cooperation 4) Organisational and ecological benefits. Details of the questions to be asked in the form of a semi-structured interview schedule is shown in Appendix One.

The case study contextual issues - pressures for environmental response: The subject of this area relates to the antecedents to the product recycling schemes, where the pressures for the establishment of the scheme are derived from and what industry specific issues affect the scheme i.e. what are the industry differences between the cases. This section will be aimed at personnel with responsibility for implementing EoL product recycling and personnel from the 'environment or social responsibility' department across both firms in a dyad.

Summary of questions

Questions	Sources
How do ecological issues impact on the organisation and the industry in general?	Main sources of issues: legislation, customers, communities, internal stakeholders, others?
What are the drivers for implementing end-of-life product recycling?	Bansal and Roth 2000
What are the industry-specific issues that effect the implementation of end-of-life product recycling?	Thierry et al 1995

Product recycling operations: This set of questions is provided partly to validate the data gathered through network mapping and also to provide more detail of the relationships between actors in the product recycling scheme. This section is aimed at personnel fulfilling an operations function in both firms of a dyad.

Summary of questions

Questions	Sources
Describe the activities involved in end-of-life product recovery and their development	(Dowlatshahi 2000; Rogers and Tibben-Lemke 2001; Thierry et al. 1995)
What are the organisational and ecological requirements and benefits of product recovery?	(Dowlatshahi 2000; Rogers and Tibben-Lemke 2001; Thierry et al. 1995)
What are the capabilities needed to achieve the requirements	Hart 1995
Are these capabilities competitively valuable (rare, socially complex, inimitable) and do they allow external social legitimacy	Sharma and Vredenburg 1998, Hart 1995

Interorganisational cooperation: The key issue here is central to the research question. This relates the nature of the inter-organisational cooperation, the resources associated with this and the outcomes of organisational and ecological benefit. The questions relate to the dyads identified in the previous section of this protocol. This section is aimed at operations and purchasing personnel with responsibility for the relationship between the OEM and recycler.

Summary of questions

Questions	Sources
Describe the type of relationship that exists between the OEM-recycler or recycler-OEM.referring	(Carter and Carter 1998; Cousins 2002; Dyer and Singh 1998; Ellram and Hendrick 1995; Lamming 1993)
Which resources does your 'partner' hold that allow the achievement of benefits	Idiosyncratic investments, asset specificity
Which resources, that are specific to the relationship, allow the achievement of benefits	Idiosyncratic investments, asset specificity
How do the aspects of this relationship allow the achievement of the organisational and ecological benefits	(Melnyk et al. 2003)

Detail of the procedure: Interviews will be held at each end of a dyad ('buyer-supplier'), for example, an interview relating to an OEM and dismantler interaction. To account for differences in organisations, more than one interview for each type of interaction will take place using respondents from different functions in both firms. The process will stop when the data being gathered show similar characteristics and no new evidence comes to light, a process often termed as 'closure' or 'saturation' (Eisenhardt 1989; Strauss and Corbin 1990). As part two proceeds it may be necessary to include further informants to fill gaps in the interview answers, i.e. from additional functional areas such as operations or marketing or additional network positions and thus the protocol is flexible in not specifying the exact number of interviews and exact respondent functions.

The interview itself will follow from the questions defined in section (and derived in Chapter Four) using the Appendix One as a schedule. The interview will start with a brief introduction of the research area and why the questions are being asked, in a manner that makes sense to the participant. The questions will then be asked in order of this protocol, but where the direction deviates to a related area this will be explored to maximise the opportunity for other emerging concepts. This flexibility in design is important for case study approaches (Stuart et al. 2002). Interviews will be tape recorded to ensure accuracy when writing up transcripts. The interview will be drawn to a close when all the questions have been answered satisfactorily, accounting for the time constraints of participants. The participant will be asked if they would be willing to review the case study report as a form of validation.

5.6.8 Stage Three - Observational and secondary evidence validation

The aim of this part of the protocol is to gain further validity by comparing data from other sources such as direct observation and organisational documents. This is often referred to as triangulation (Jick 1983; Stuart et al. 2002). The operational aspects of end-of-life product recycling are part of the case study design and therefore observation of the tangible outcomes is possible. For example it is possible to visually observe operations that meet the regulations such as collection of products, depollution of products and reprocessing of products. This section is aimed at the site level and thus plant managers or operations managers are the target respondents.

Summary of questions

Questions	Sources
What types of activities are involved in the relationship referring to appendix 1 based on	(Dowlatshahi 2000; Rogers and Tibben-Lemke 2001; Thierry et al. 1995)
What are the organisational and ecological benefits of the relationship	(Carter and Ellram 1998; Melnyk et al. 2003)
Give examples or demonstrate how the resources associated with the relationship provide organisational and ecological benefits	Melnyk et al 2003

Site visit: The aim of the site visit is to validate claims that there are organisational and ecological benefits of collaboration between the firms. Where benefits are claimed by key informants, the researcher would ask to see how this affects operations, for example lowering costs or provides ecological benefits, such as meeting the standards set in the regulations.

Observation sheets: Observation sheets would be used to record the pertinent data on the site visit, covering issues such as activities carried out, compliance issues, low cost approaches. The 'table shell' will be used for each of the site visits to ensure a common approach to recording the observation. Photographic evidence will also be used, where permissible, to help present specific operations and assets which allow organisational and ecological benefits. The table shell is shown in Appendix One.

Documented evidence: Where possible, and confidentiality allows, the researcher will ask respondents to provide documentary evidence that supports the extent of collaboration, and also evidence to show organisational and ecological benefits (meeting standards or prescribed level of performance). The types of documents requested will include contract agreements, press releases, performance records (operational, financial and ecological). A further source of evidence validation come from documentary sources such as company reports detailing product recycling activities and trade journal descriptions. The structure of observation and type of documentation are detailed to informants using the sheets shown in Appendix One.

5.6.9 Stage Four - Analysis plan and case study reports

Stage four in the case study protocol is the analysis. As a form of validation, the case summary reports were compiled and forwarded to the participants of the research and therefore the structure of the reports were partly determined by the audience who were predominantly from industry. Yin suggests that the linear-analytic structure is most appropriate for this type of report (1994).

The analysis of the case data can be referred to as "making sense from chaos" (Stuart et al. 2002 p.427), and so significant time was reserved to complete this task. The predominant analysis method involved structuring the data in a variety of patterns to allow comparison within and across cases of the key categories and concepts derived from the literature and the data. Matrices were a useful method of arraying data to perform these types of analyses (Miles and Huberman 1994). To aid the sorting, structuring, categorising and comparison of the qualitative data obtained in each and across the case studies, the computer software package NVivo was used.

The following table details the coding strategy used initially. These codes were derived from the conceptual framework developed in Chapter 4. The data entered into NVivo was coded using the following categories. Additional categories were developed in NVivo when they emerged from the data from each case study.

Table 5-6 Initial coding categories derived from the conceptual framework

Concept category	Coding acronym	Sub-concept
Industry context	IndCon	-
Driver	Driver	Competitive driver (CompDr) Legitimacy Driver (LegiDr) Ethical driver (EthiDr)
Product recovery and recycling operations	ReOp	Types of operation ReManufacturing (Reman) Refurbishment (Refurb) Recycling (Recycle) Take back logistics (TBLogs)
Resources	Res	Specific assets (SpecAss) Dedicated assets (DedAss) Skills (Skill) Shared vision (ShareVis) To be defined from data
Capability characteristics	CapChar	To be defined from data Capabilities developed (CapDev) Capabilities acquired (CapAcq)
Organisational Benefit	OrgBen	-
Ecological benefit	EcoBen	-

Individual case study analysis: The analysis took the findings of the 3 sections of the protocol procedure for each of the cases and brought these together under a common format divided into the core concepts defined in the research. The concepts were compared to the data (interview transcripts, relationship mapping diagrams, and observation notes) and allocated according to the sources of data. Additional concepts derived from the data were allocated to further categories and compared with existing concepts.

NVivo was used as the database for all the documentation and transcripts used as primary data for this study. This database was also used to present summaries of the coded extracts from all the interview transcripts on a specific issue. Examples of how NVivo was used are included in Appendix Four.

Outline of individual case study reports: The individual case study reports (findings section in the thesis) were structured using the structure determined by the research questions. This continued as follows: 1) contextual issues 2) Background details of the product recycling activity 3) IO Cooperation, acquisition and development of capabilities 4) Organisational and ecological benefits.

Cross-case analysis: The cross case analysis involved comparison of the three cases using the concepts derived from the literature and the additional categories that have emerged from the data. Again using matrix tables allowed the comparison of individual concepts across cases. This was again based on established methods of analysis such as those described in Miles and Huberman (1994).

Outline of cross-case study report: The cross-case study report followed the same structure as the individual cases, but provided explanation of each of the concepts and categories across the case differences and similarities. The report then developed an explanation of the relationships proposed in the research questions with the aim of demonstrating the suitability of these answers.

Feedback to other cases: The analysis was carried out concurrently with the data collection where possible. This allowed feedback into other case studies so that any new categories or concepts emerging from the data were deliberately incorporated to ensure replicability and comparability across the cases.

5.7 Conclusions

This chapter has outlined the argument for the methodological approach based on previous studies in the field and the research questions developed in Chapter 4. The case based approach links the ability to answer the how and why questions relating collaboration and end of life product recovery, to the need for empirical research into the mechanisms of developing capabilities for product stewardship.

The following Chapter summarises the findings from the study reflecting the methods that were described previously and is structured by the individual elements of the research questions.

Chapter 6 Findings

6.1 Introduction

This chapter presents the key findings of the data collection phase of the thesis. The findings are presented in the order of the case studies in the tyre sector, the office equipment sector and personal computer sector. Each case is divided into the context, drivers, operations, relationships, capabilities and benefits as described in the conceptual framework (Chapter 4). The data is presented across two relationships within each case section. The following figure provides an outline of this structure.

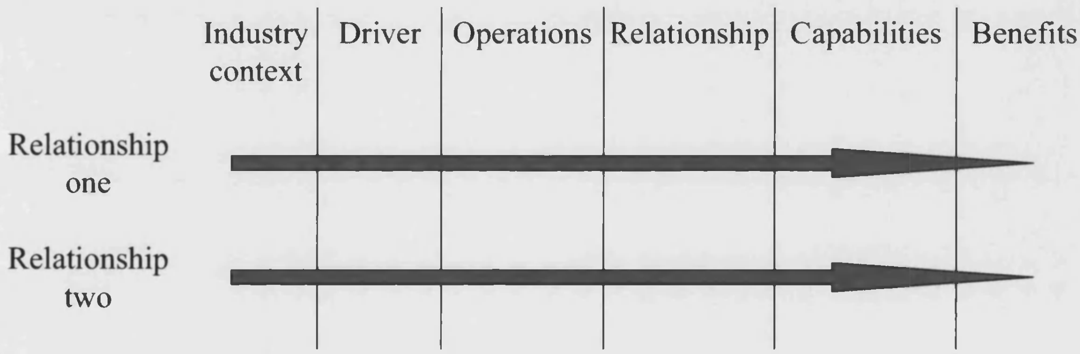


Figure 6-1 Structure of the findings chapter

Sixty-five primary and secondary interviews were carried out across twenty-seven organisations. In addition, relationship mapping sessions, site visits and examination of company documentation were undertaken. The interview respondents were chosen based on those individuals who had specific knowledge concerning the operationalised research questions. More than one individual per organisation was also included in the study to obtain more than one perspective and improve validity. Furthermore, where possible a number of functional areas were included in the interview groups to gain perspectives from a variety of sources (e.g. managers from Operations, Sales and Marketing, Environmental, Health and Safety).

Table 6-1 List of Interviews

	Organisation	No of Interviews	Function
			Pilot study (Mobile Phones)
1	OEM T-Mobile	2	Environment Advisor
2	Provider Shields	2	Director , MD
			Automobiles
3	GM	7	Environmental Policies Mgr, Environmental Mgr, ELV coordinator
4	Autogreen	3	Marketing Manager, , ELV Director
5	Bridges	3	Managing Director, Environment Manager Operations
			Tyres
6	Michelin	4	VP ELT, Mgr
7	Sapphire	5	MD, Ops Mgr
8	Lafarge	3	Sales and Marketing Mgr, Operations Mgr
			Photocopiers
9	Xerox	7	Mgr, EH&S, Assets and Prod Returns, Ops Mgr
10	Covertronic	3	Operations Manager, General Manager
11	Flextronic	3	Ops Mgr, SSC Operations
			Secondary interviews (Automotive, Electronics and Policy)
	Automotive & tyres		
12	Nissan	3	Senior Engineer, Product homologation, Vehicle Design Director
13	Auto Recycling Ndr	1	GM
14	Honda	2	Chief Eng, HMUK, Environmental Manager
15	Volvo	2	Environment Manager
16	VW	1	ELV Coordinator
17	CARE	1	Manager
18	PSA	1	ELV coordinator
19	Visteon	1	Materials Design
	Electronics		
20	RecommIT,	1	Director
21	Engelhardt	1	MD
22	T-Mobile	2	Environment Advisor
23	Nokia,	1	Environmental Manager
24	HP	2	Environmental Manager, Environmental Programs Mgr
25	Fujitsu Siemens	1	Mgr Policies
26	TAM	1	Director
	Policy		
26	DTI	1	ELV policy
27	SMMT	1	ELV policy
	Total interviews	**65**	

The chapter starts with the findings of the pilot study that was carried out on one relationship between mobile phone provider and recycling service provider, recovering mobile phones. The chapter then follows with three fully detailed cases consisting of two relationships each: Tyres, photocopiers and automobiles. Each case description provides a set of drivers from the OEM perspective. This is followed by an explanation of the relationship characteristics across both dyads in the case. The descriptions of the capabilities are derived from the data and also categorises each capability as pre-existing, acquired or developed. The case continues with an explanation of the benefits from organisational and ecological perspectives.

6.2 Pilot study findings

A pilot study was organised to test the case study protocol and operationalise the research questions through the interview schedules. The characteristics of the case include the relationship between a mobile phone service provider and a recycling service provider. Within this sector the manufacturers (OEMs) do not currently organise product take-back, therefore the service provider was chosen in this place.

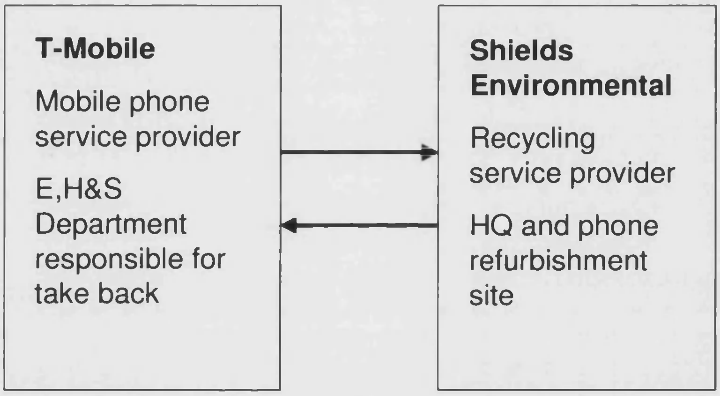


Figure 6-2 Scope of the pilot case

This pilot case was based on one mapping session with T-Mobile and four interviews with personnel from T-Mobile (phone service provider) with responsibility for product take-back and high level personnel from Shields environmental (recycling service provider) and supplemented by a two secondary interviews.

Table 6-2 Interviews for the pilot case

Primary Interviews	Function	Number
T-Mobile	EHS Manager, EHS Advisor	2
Shields Environmental	Director, MD (Fonebak)	2
Secondary interviews		
Nokia	Environmental Advisor	1
TAM	Director	1
	Total	**6**

6.2.1 Context

It is estimated that there are over 1.28 billion mobile phone subscribers globally. In the UK, over 77% of the population have at least one mobile phone. Consumers in the UK replace these approximately every 18 months. This means that over 15 million people replace their phones each year in the UK. Disposal of these phones would generate 7,500 tonnes of potentially harmful landfill waste. Mobile phones contain a number of substances including precious metals and some potentially hazardous materials. These materials are harmless until they are discarded to landfill where they degrade and can cause damage to the environment. These properties of mobile phones has meant that they will be subject to the WEEE directive, and therefore companies involved in their production, distribution and sales are beginning to put systems in place to provide alternatives to disposal.

This pilot study refers to the Fonebak scheme for recovering phones from end users, a free take back service offered by the mobile phone service providers. The original system for taking back end of life phones was organised by a consortium of six mobile providers in the UK. The consortium was fronted by ECTEL, an industry body set up to represent the service providers. Since the late 1990s, the consortium has evolved with now only five members. The consortium approach led to the selection of one service provider which was contracted to find suitable routes for end of life phones, that were commensurate with the motivations of the service providers, e.g. an ecologically sound approach, that was economically feasible. The consortium selected Shields Environmental Ltd based on their previous experience of dealing with end of life assets for British Telecom from the 1980s. A significant feature of this consortium is that mobile phone OEMs are not members. After a trial period the scheme devised by Shields Environmental was formally launched as Fonebak in 2003.

6.2.2 Company Background

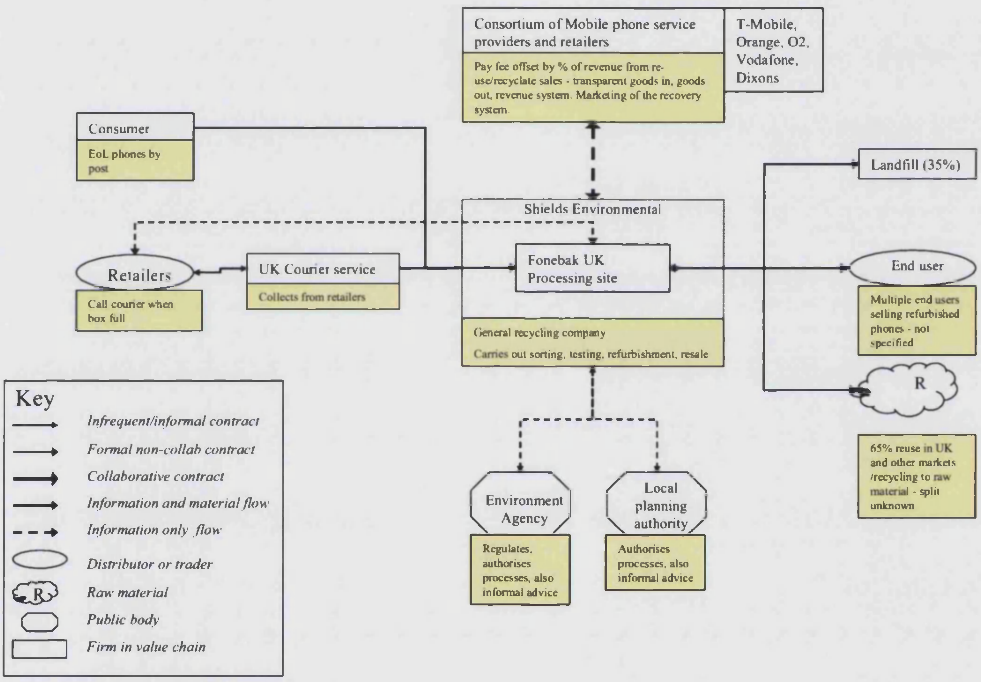
T-Mobile

T-Mobile is a German owned telecommunications service provider. The focus of the study was at the UK HQ, where the manager responsible for mobile phone take back was directly involved in the management of T-Mobile's role in the Fonebak consortium.

Shields Environmental

Shield's was started in the mid-1980s, primarily dealing with asset management for British Telecom. Their main activity at this time was in replacing telephone exchanges and network infrastructure and finding suitable routes for disposal (including recycling). They describe their role as being in value and risk management for the telecoms industry. In 1998, Shields had processed over 20,000 tonnes of equipment. Importantly a key development was the request by BT for Shields to deal with their PCB problem (driven by the North Sea Treaty), whereby any of their hardware containing PCBs had to be decommissioned and the PCBs disposed of in an environmentally friendly manner. Shields claim this to be Europe's largest environmental project, and as such enhanced their capability to manage large scale environmental projects.

Mobile phone product recovery operation



6.2.3 Drivers

Perhaps the biggest driver in terms of motivating product take back for T-Mobile is the effect of allowing irresponsible disposal on their reputation and image. *"the key point in this is reputation, ethical issues, CSR and image, its about doing the right thing" T Mobile EH&S Manager.* This is particularly the case because of the German influence on T-Mobile, where T-Mobile has had to respond to environmental regulation for longer than in the UK. The members of the consortium also receive revenue from scrapped/recycled phones and re-used phones sold to other countries, for example in Africa. The difference in the fee paid for free collection and Shields' costs (and agreed margin) is returned to the members of the consortium. A third reason why the scheme was set up links to the aim to meet the WEEE directive. At the time of setting up the Fonebak scheme it was unclear who exactly would be responsible for free returns of phones, hence the service providers pre-empted the legislation by putting in a system which complied to the regulation (as it was proposed at the time).

6.2.4 Operations

The collection system is based on end users (consumers) returning their old phones to the retail outlets where they collect their new phones. Most outlets have a box that, when full, is emptied by Fonebak (a courier collects the box and replaces it with an empty one). In fact there are 900 outlets with this system in place, in the UK, and 800 of these also hold a stock of free post bags which can also be used to post the used phones to the Fonebak site.

The Fonebak site in Thurrock, carries out testing, sorting, refurbishment and packaging of used mobile phones. Where phones are found to be truly at the end of their life they are recycled (the batteries separated and sent to SNAM, a battery recycling company in France to recovery the battery materials) and the rest of the phone is sent to another recovery contractor who recovers other valuable metals from the phone (e.g. copper). If phones are re-usable, they are subjected to further testing to check if any refurbishment is required. In this case 'good as new' phones are re-packaged, and lower quality phones pass through a refurbishment process and then are packaged for sale. Phones for re-use are then most commonly sent to Africa (Nigeria for example) to sell as nearly new, in the expanding mobile phone market there. Overall, the Fonebak site processes around 150,000Kg of phones each year, with over 65% being recycled or reused (65% being the initial target set in the WEEE Directive).

6.2.5 Relationship

The following table outlines the key characteristics of the relationship between T-Mobile and Shields Environmental.

Table 6-3 Relationship characteristics

Characteristic	Description
Specific investments	none
Certainty	uncertain returns from retailers variety of products WEEE directive requirements
Dependence	consortium based on one provider switching costs issue

Risk sharing	consortium, pay annual fee , covers cost, then revenue = excess
Duration	3 year rolling contract based on expected level of returns
Information sharing	open book systems on revenues from sold products details of the distribution network sales information for forecasting
R&D	not involved
Knowledge sharing	OEMs not involved so not design info
Capacity planning	no joint system

The key feature of this relationship is that while there are many aspects of collaboration, such as information and risk sharing it is fundamentally a consortium approach, where all the consortium parties have the same relationship. Therefore the benefits are for the group as a whole and not one individual alone.

6.2.6 Capabilities

Shields Environmental have developed capabilities for phone depollution (removing the battery for example), stock control (of a large number of different products across many brands) and inventory management (being able to track products over time for example). None of these activities however, appear to be competitively valuable in the theoretical sense (i.e. VRINN).

T-Mobile like any other service provider has a focus on marketing the product-service package and the distribution network through which it sells. To an extent T-Mobile can use these resources to promote the Fonebak scheme, to raise its visibility to customers, as can any other of the consortium members.

Where capabilities in their academic sense appear competitively valuable is the use by Shields of an established network of 'suppliers', i.e. valuable markets for waste or reuse. This is a capability – to find profitable end markets for used phones – that has been developed over many years through working in the business of selling end-of-life products. This is coupled with the ability to coordinate the recycling chain (the reverse supply chain) in a way that maximises potential revenue. Alongside this, Shields is able to do this while accounting for environmental concerns of various stakeholders, and so Shields has implemented EMAS for the past six years (an environmental management system, certified at European level).

These capabilities are not the result of any particular characteristic of the relationship between T-Mobile and Shields, in fact these are completely stand alone. In a sense, T-Mobile could be thought of acquiring the capability to recovery phones through the consortium, and Shields acquiring a marketing presence, through the service providers, for the Fonebak service. The consortium members have equal access to the benefits of Shield's capabilities, which could be viewed as at an industry level.

6.2.7 Benefits

The positive reputational effects appears to be the key outcome for T-Mobile. The revenues gained from recovering the 'end of life' phones will never become significant enough for this to be a major reason for undertaking product recovery. Furthermore, the development of the WEEE Directive since the Fonebak scheme was set up, means that in fact OEMs are likely to be responsible for much of the free take back requirement, questioning whether T-Mobile has gained any benefit from pre-empting legislation. The link to enhanced reputation however is further complicated by conflicting opinions about the acceptability of 'dumping' Western waste on African states who are potentially less well equipped to dispose of phones in an environmentally responsible manner. This was certainly one of the concerns of T-Mobile during the interviews and could affect the future membership of T-Mobile in the consortium.

From an ecological perspective, there is certainly a benefit in terms of diverting end of life phones from landfill, but it seems that those phones that are refurbished and/or resold to African states are at risk of disposal in a less than responsible manner.

6.2.8 Discussion

The central theme of this case is that it is an example of the consortium approach where members pay an annual fee and then expect revenue from sales of the products that are recovered from the market to cover costs. The main aim, therefore, is to subsidise the cost of recovering end of life phones in an environmentally sound manner. Capability development is actually limited in that OEMs are not part of the consortium, so that there is no feedback loop from recovery/recycling back to the design of the product. The mobile phone service providers acquire resources (collection, testing, refurb, distribution) from a specialist in the field (Shields) through the consortium, and there are no competitively valuable capabilities developed as a result of the relationship as all members have equal access to the resources available.

6.2.9 Conclusion

To conclude, this consortium based approach 'controls' the market mechanism, in that all service providers pay the same regardless of the characteristics of the products they are responsible for. There is also a potential lack of competition as there is only one service provider (Shields) and makes this scheme monopolistic in nature, despite the initial bidding process. However, an open book, collaborative relationship prevents risks of opportunism on the part of Shields.

Furthermore, the relationship has other elements of a collaborative approach for example the duration of membership to the consortium is initially 3 years, there is an element of risk sharing in that the consortium members pay an annual fee that at least covers cost for recovering the phones from the distribution channel and there are significant amounts of information sharing both on the extent of recycled materials, but also financial information on the revenues gained from selling valuable materials such as heavy metals and the structure of the distribution network.

In essence, mobile phone service providers completely 'contract out' the responsibility for product take back operations in order to enhance reputation. However, not being in control of exactly where the end of life phones could be potentially damaging to corporate reputation in the longer term.

6.3 Lessons from the pilot case study

6.3.1 Case approach

It is clearly important to obtain multiple perspectives. As the issue of selling into Africa demonstrated, concentrating on one perspective (for example the recycler case), would have missed this important aspect of the influence on corporate reputation.

As much of this activity was driven by concerns about potential European legislation there is a need for more contextual data from other sources especially if the case is consortium based or an industry-level approach. Furthermore, as this case showed, there are stakeholders with significant influence over the operations studied and therefore it would be important to include views from these stakeholders (e.g. legislators and in this case OEMs).

6.3.2 Data Collection

From this case, it appears that the drivers for end of life product recovery are mainly from the OEM's perspective, as the OEM is the main target for European legislators. The interviews and site visits helpful, especially to understand operations that had been put in place. In this case it was only possible to record one of the interviews, and therefore extracting quotes to emphasise points or to complete the analysis in Nvivo was problematic. It is intended to strive to obtain recorded interviews where possible to counter this problem.

The case benefited from company data and documents, even though these were not given for further analysis. For example, a promotional video demonstrated who was involved in the consortium and outlined the main operations. Viewing the information system for tracking products, and revenues, offered the opportunity to determine the level of information sharing.

Within this pilot study, it was not possible to include the views of the OEMs (at least in the primary interviews). It would be beneficial to ensure that OEMs are included in the primary data collection phase, as responsibility to take back of products is likely to rest with them in the future. It should also be emphasised in the interviews that the key area of interest is the relationship itself and how this enables the operations to provide benefits, through the acquisition and/or development of capabilities.

From the discussion of the pilot study the following changes were made to the case study protocol and interview schedules (by having 3 separate schedules: 1) Secondary interviews 2) OEM interview and 3) Contractor interview. The following issues were also considered: Contextual issues (to be included in the interviews with all); All issues for OEM (Context, drivers, operations, relationships, capabilities and benefits); Limit the topics covered for interviews with 'partner/contractor' – only operations, relationship, capabilities and benefits. In addition, a number of the interview questions were also re-worded to improve understanding on the side of the respondent and the next section presents the results of the network mapping session within the selected cases to identify suitable relationships for the in-depth case study descriptions.

6.4 Relationship Mapping Results

6.4.1 Tyre industry mapping

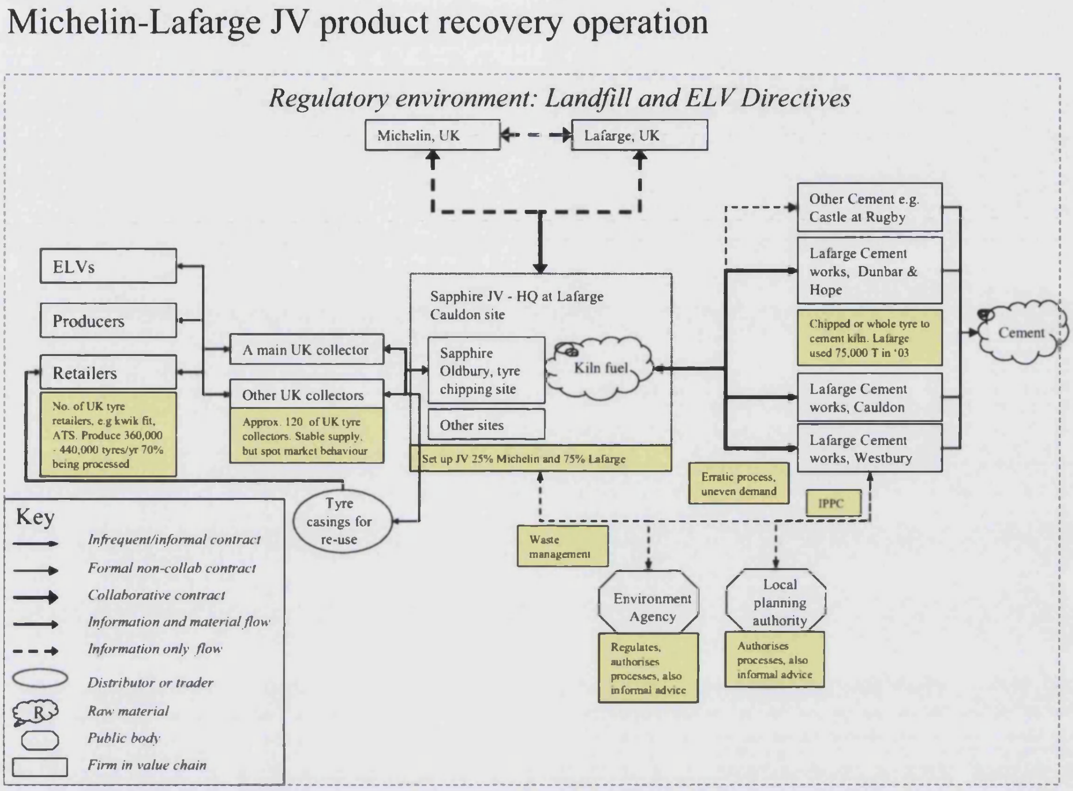


Figure 6-3 The tyre industry relationship network map

A mapping session between the Michelin and Sapphire personnel in the UK (at the Sapphire HQ in Cauldon) identified a number of relationships between Michelin and other players in the product recovery supply chain.

The session was used to map the relationship network between Michelin and the other organisations involved in the product recovery network in the UK. In this case Michelin is directly linked to Lafarge and Sapphire Energy Recovery Ltd through a joint venture. There are direct links to the upstream of tyre collection through WTS, a tyre collector and number of other smaller collectors. Michelin also has links with retailers, through a franchise organisation. The link to the Lafarge cement works are through the JV company, Sapphire.

A recent joint venture had been set up between Michelin and Lafarge (a cement and building materials manufacturer) to provide services for last users of end of life tyres, in the light of recent legislative developments to end the dumping of tyres in landfill. The view from Michelin was that collaborative relationships had been set up between themselves and Lafarge and the new joint venture company, Sapphire Energy Recovery. The identified relationships are shown in the figure. The relationships between Michelin, Lafarge and Sapphire Energy Recovery form the basis for the first case study.

6.4.2 *Photocopier industry mapping*

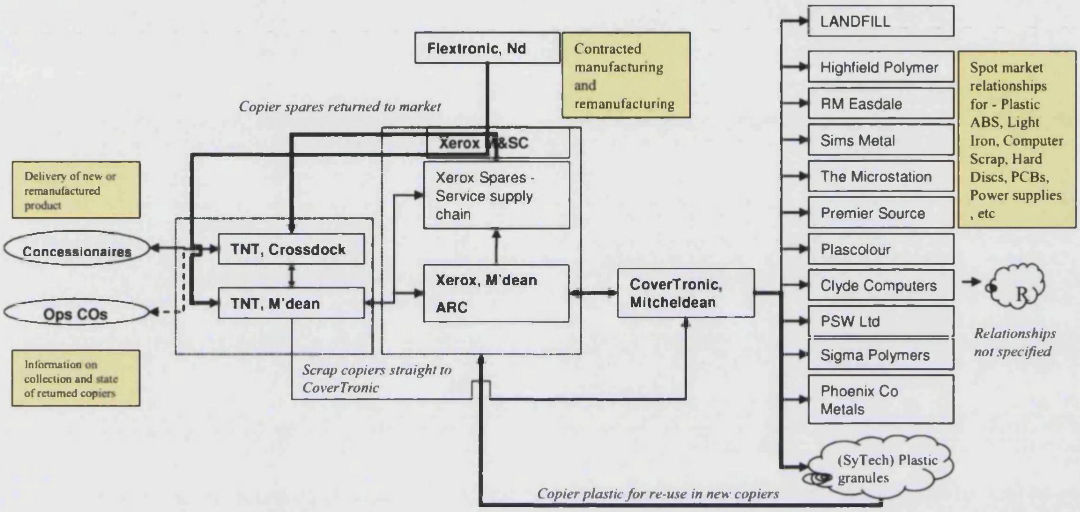


Figure 6-4 Photocopier relationship network map

The relationship network mapping session with Xerox took place at their Asset Recovery Centre (ARC) in Mitcheldean with representatives from the European HQ and operational staff at the ARC. The session revealed a number of relationships set up to cover the main activities in the product recovery supply chain, including logistics providers, recycling and remanufacturing contractors as well as internal functions that are integral to the product recovery process (such as ARC).

Xerox has direct links to customers through the leasing programme for copiers and also through the Operating Companies (Ops Cos – sales companies in each country) and concessionaires, retailers who sell products independently of Xerox. Xerox also has a contract with TNT for product distribution logistics. This arrangement also includes returns of end of life products. The Asset Recovery Centre has a specific relationship with Covertronic to recycle EOL products. Additionally, Flextronics has taken over some of the manufacturing operations in the Netherlands.

During discussions with the Xerox personnel, two key relationships were identified as important in the current product recovery process and the planned changes to meet new legislation on recycling of electronic and electrical equipment. These were with Covertronic (based at the ARC site) and Flextronic (based at the supply chain centre in the Netherlands) where the remanufacturing operations had recently been outsourced. Based on the length of contract, sharing of information and knowledge and nature of assets at the contractors (site and personnel specific in both cases), these were viewed as the most collaborative relationships of those identified. These two relationships with Xerox form the basis of the second case study.

6.4.3 *Automobile industry mapping*

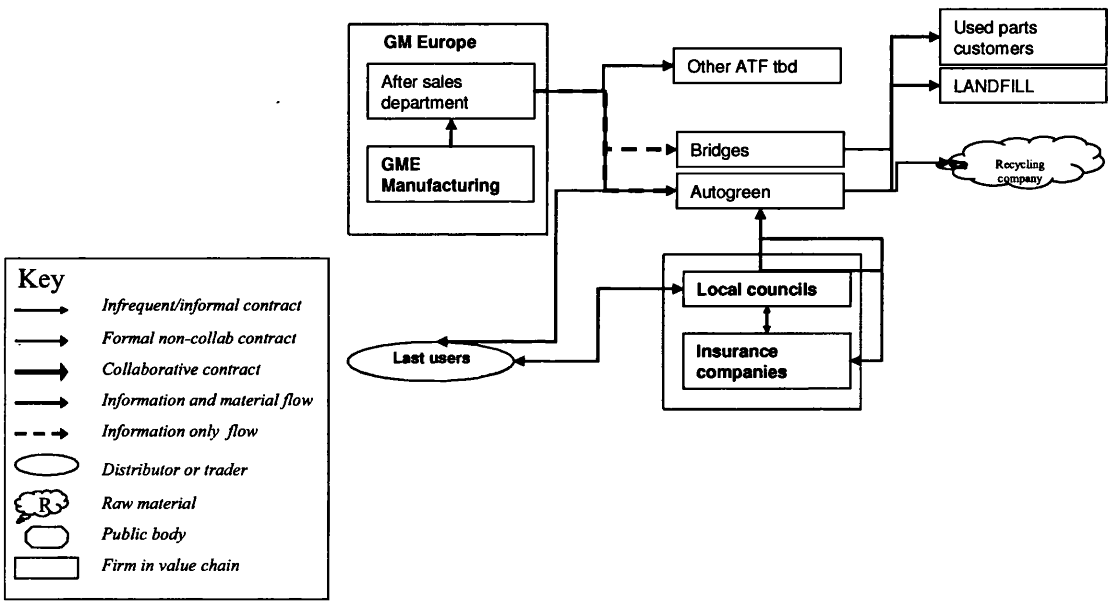


Figure 6-5 Automobile relationship network map

The network mapping at General Motors involved a number of personnel from the After market and environmental policies departments, at their UK office in Luton. The session revealed that this is an emerging set of relationships (based on the contracts required by the transposition of European legislation on end of life vehicles). At the time only two relationships had been set up for product recovery to meet the new legal regime: Autogreen and Bridges. Previous relationships based on manufacturing scrap (vehicles that had not been assembled to the correct standard in the early phases of manufacturing) and also studies to assess the dismantlability of current designs. These relationships were not planned to meet current nor future legislation and hence were not included in the analysis. The OEM (GME) does not have collaborative relationships with the last users, or those authorities involved in collecting crashed or dumped vehicles (insurance companies and local authorities respectively). The identified relationships had characteristics of collaboration and viewed as suitable for the case study. The next section describes in detail the results of the three in depth case studies.

6.5 Case One: Tyre Industry

6.5.1 Introduction

The first case study in this section is of the tyre sector where two relationships were studied.

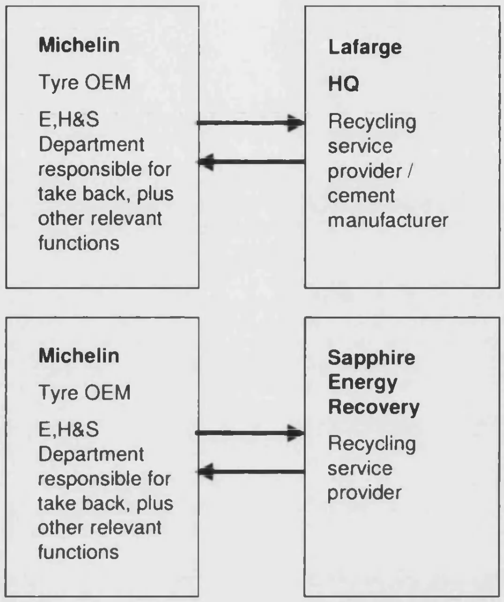


Figure 6-6 Scope of Case One - Tyres

The case was initially based around Michelin, a tyre manufacturer who perceive a requirement to set up a process for end of life tyre recovery and ecologically sound disposal. After an initial mapping session in the UK, two collaborative relationships were identified and these form the basis of the case. The two relationships represent differences in the linkages between the firms and represents a case of collaboration (without actually integrating) in the form of a joint venture. The three firms in the case link to the joint venture and demonstrate different relationship characteristics within the same joint venture.

Table 6-4 Interview list for Case One

Primary Interviews	**Function**	**Number**
Michelin	UK Director, VP ELT	4
Lafarge	Ops Manager, Sales & Marketing Mgr	3
Sapphire	MD, Ops manager, Site mgr	5
Secondary interviews		
DTI	Advisor	1
BRF	Policies	1
SMMT	Policies	1
	Total	**14**

6.5.2 *Industry context*

At present, one-third of the 40 million tyres discarded every year in the UK end up in landfill sites, but from July 2006, European legislation will ban this method of disposal. The contextual background to the tyre industry reflects the nature of the product and market conditions. In the UK tyres are predominantly sold through specialist retailers of replacement tyres, as well as through vehicle service centres, although in some cases tyres are supplied directly to fleet owners. The nature of the product means that the market is fiercely competitive, with severe competition based on price.

The background to tyre recycling is fairly established with a number of manufacturers having environmental policies. The re-use of waste tyres is common place. Tyres which have not reached their ultimate end of life are commonly remoulded into second use tyres that are then sold on the re-mould market. The judgement of whether a tyre is truly at the end of its life or can be remoulded is generally taken by the collectors of tyres, who are paid by retailers to remove waste tyres. Historically tyre collectors operate as SME businesses, often family owned one or two person firms, who own a collection vehicle and establish a set of customers to sell tyres to (either to remould or dispose of in another way). In the case of Michelin, they have an established environmental policy that includes the treatment of end of life tyres (ELTs). It is the global policy of Michelin to provide a system of collection and treatment of their ELTs within each of the major markets it sells. Michelin claim to provide a system within each of the European markets including the UK which utilises the existing collection infrastructure whereby Michelin specifies to their retailers which tyre collectors they can use to ensure that ELTs follow a route that has been agreed and verified by Michelin.

For the selected tyre reprocessor in the case study (Lafarge), the existence of a perceived environmentally sound route for the treatment of ELTs led to contracts with tyre collectors to bring a supply of tyres to Lafarge owned (previously Blue Circle) cement kilns. The cement industry has been seeking alternative fuels for kilns operation for number of years, partly driven by high authorisation fees for kiln stack emissions. Alternative fuels can reduce the quantity and improve the quality of air emissions, thus reducing fees. The combustion of tyres is recognised as producing less of the pollutants subject to regulation, compared with standard fuels such as coal.

In the UK the supply of ELTs as combustion fuel in cement kilns is seen as unreliable and subject to many fluctuations in volume and quality of stock. In an attempt to improve the supply of tyre fuel to Lafarge kilns, a joint venture was set up between

Michelin (indirectly the supplier of tyres) and Lafarge (a consumer of ELTs) in order to dedicate personnel to the control of the ELT supply chain and the effective use of ELTs in the cement production process.

This joint venture is the basis of this case which examines the drivers for setting up the JV, the operations involved, the characteristics of the relationships and capabilities that have developed and the perceived benefits of the relationship that exists.

Michelin

Michelin Tyre Plc manufactures and distributes tyres, tubes, wheels and accessories mainly in the United Kingdom. The company is a wholly owned subsidiary of Compagnie Financiere Michelin which is incorporated and registered in Switzerland and the ultimate holding company is Compagnie Generale des Etablissements Michelin which is incorporated in France. The firm produces more than 190 million tyres a year. Compagnie Générale des Établissements Michelin sells about 36,000 products, including tyres, wheels, and inner tubes used on passenger cars and trucks, aircraft, bicycles, and agricultural vehicles. Included in Michelin's stable of tires are brands recognized all over the world (BF Goodrich and Uniroyal), as well as more regional lines (Kleber in Europe and Warrior in China). Other company products include travel publications such as road maps and travel guides. A vertically integrated corporation, Michelin owns rubber plantations and factories around the globe[26].

Lafarge

Blue Circle Industries plc (UK) who initially started the joint venture with Michelin, is an international group of heavy building materials companies focused on cement. Blue Circle has operations worldwide, with shares in Asian, African and Latin American companies. The company was acquired by Lafarge (France) in summer 2001[27]. Lafarge SA also produces construction materials. The company ranks among France's major corporations in terms of sales and employs people in 75 countries. The operations are organized into four Divisions, each of which holds a leading position in its market: Cement, Aggregates & Concrete, Roofing and Gypsum.

The Cement Division covers operations throughout the world. In 2004, this division had industrial operations in 43 countries. This division offers various cements adapted for

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26 http://web.lexis-nexis.com/executive/Hoover's Company Records - In-depth Records, October 11, 2005

27 http://web.lexis-nexis.com/executive Business Monitor International Ltd.

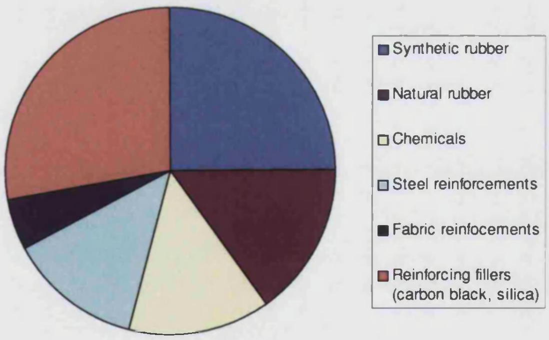
use in all conditions (including cements adapted to exposure to seawater, sulphates and hostile natural environments); special cements: white cement, oil-well cements, blended silica fume, fly-ash, pozzolana and slag cements; road surfacing hydraulic binders; natural lime hydraulic binders for construction; masonry cements; and ground slag[28]. The UK arm of Lafarge operates a number of cement works in the UK that consume tyres as part of the fuel mix. These plants include Westbury, Cauldon and Rugby.

Sapphire

Blue Circle Industries Plc, London, England (now Lafarge), cement manufacturer, entered into a joint venture with Michelin Tyre Plc, Stoke-on-Trent, Staffordshire, England, manufacturer of rubber tyres, to form Sapphire Energy Recovery Ltd. The new company will prepare scrap tyres for use as a fuel in cement kilns. The main business function of Sapphire has now widened to the acquisition, process and sale of used and scrap vehicle tyres[29].

Product characteristics

It is also important to consider the impact of product characteristics as shown in the following figure.



Average ELT Material Composition

Total UK ELTs per year	**52,000,000**
Total Michelin ELTs per year	**c.10,000,000**
Number of product components	**c.200**

Figure 6-7 Product characteristics of ELTs (Source: Michelin 2004, DTI)

As the figure suggests, tyres are rather simple in terms of material composition and product components. On the other-hand, the volumes of waste tyres in the UK is very large and recovery processes have to be able to handle these large quantities.

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[28] http://web.lexis-nexis.com/executive/The McGraw-Hill Companies, Inc. Standard & Poor's Corporate
[29] http://web.lexis-nexis.com/executive/Copyright 2000 Corpfin Ltd

6.5.3 Drivers

The EU Landfill Directive and generic producer responsibility environmental policy have both provided a backdrop to why Michelin have established a take back scheme for ELTs in the UK. While there is a global environmental policy, this is seen as resulting from legislative pressure on the whole. Specifically there is no regulation in the UK to actually take back and responsibly dispose of waste tyres. However the landfill directive aims to ban the disposal of waste tyres in the EU from landfill in 2006 and ban the disposal of shredded tyres by 2010, without specific responsibilities for OEMs. Hence, this regulation has no direct impact on tyre manufacturers. Michelin's view is that pending producer responsibility regulation could force them to be responsible for their own tyres and so pre-empt such action by setting up the present scheme. The following table summarises the data that was coded relating to drivers, these second order codes are grouped into the three main areas identified in the literature: competitiveness, legitimacy and ethical drivers.

Table 6-5 Case One - Drivers for product recovery

Second order code	Established driver category
Cheaper input to manufacturing as a fuel Lower authorization cost from local authorities	Competitiveness through lower costs
Reduce the cost to the end users through competition	Competitiveness through lower consumer costs
Monopolistic / anti trust implications of the process	Legitimacy – avoid antitrust
Indirect legislation forcing an alternative disposal route	Legitimacy – indirect legislative pressure
Maintain environment standards through ISO14001 and EMAS	Legitimacy
Focus on being legal Indirect legislation forcing an alternative disposal route	Legitimacy – threat of legislation
The public don't accept the new process The negative arguments may be distorted	Legitimacy – threat to legitimacy

The core set of drivers for Michelin relate to the general policy to provide an ELT recovery system in each country.

> *"The Michelin group is pushing, to ensure that ELTs are properly managed wherever* it is, particularly in Europe, but wherever it is in the world." VP ELT Michelin
>
> From the perspective of Lafarge, the key driver for dealing with ELTs is the need for an alternative, more environmentally friendly fuel supply. The driver to set up the joint venture is to control that supply of fuel from the market place, which is typically volatile and unprofessionalised.

"we had a number of discussions with different producers and it led to an accommodation with Michelin, who wished to be seen to be environmentally responsible, who believed they could bring something to the supply chain, their marketing abilities, not just for finished products but therefore also extending their marketing capability to the disposal of their product," Sales Mgr Lafarge

The issue is rather more involved because there are other competitive reasons for using tyres as a fuel, such as lower cost due to fuel prices and authorisation fees plus the effect on company image (which could be viewed as positive or negative).

Overall, the prime motivations for the joint venture are discharging the company policy (on Michelin's side) and improving supply stability (on Lafarge's side).

6.5.4 Operations

Table 6-6 Case One - Operations in the tyre industry

	Collection Transport	Sorting Assessment	Depollution dismantling	Repair Refurb Reman	Recycle Reuse
Michelin	-	-	-	-	-
Lafarge	-	-	-	-	Recycle tyres through energy recovery and consume into cement materials
Sapphire	Transport from chipping site to cement work		Tyre chipping operation	-	-

Tyre collection

The tyres in the UK market are collected from the service centres by established collectors. There are a great number of these in the UK, and are characterised by small firms typically family owned. The retailer will call their collector, often a local firm, when the stocks of used tyres reaches a certain level.

The tyre collector will then transport the tyres to the collector's depot to sort them into re-tread tyres and ELT. In this case study, the specific retailer and franchise of Michelin (ATS), is directed to use a specific large scale collector in the UK (Waste Tyre Solutions). In order to maintain an annual volume equivalent to the annual sales of Michelin tyres, this collector is then required to take the tyres to the specified processor, in this case Sapphire Energy Recovery, the joint venture between Michelin and Lafarge. The depot of the collector is co-located to the chipping centre of Sapphire in Oldbury.

On the surface the process appears straight forward but as the following quote suggests, supply stability is traditionally difficult to maintain.

> *"The retailer has traditionally abdicated his responsibilities, to the collector, he says come and take my tyres away, 40p a tyre, just make sure it goes somewhere legal, I don'' mind where I leave that to you, so the then collector has custody of some money, custody of the responsibility and he'll play the field, so the levels of formality between retailer, and collector and processor in the supply chain are as loose as a whores draws, they don't exist, generally, it is beginning to change, but it is a chaotic disorderly market where the coin is king." Manager, Michelin*

> *"it is the most difficult supply chain in the world that I've ever had an involvement in 37 years of procurement and supply management experience." Managing Director, Sapphire*

Tyre chipping operation, transport to cement kilns and

Sapphire receives tyres, by truck from the collectors. The majority (17000 T in 2003) is from the Michelin specified collector, from the franchised tyre service-centres across the UK (ATS). The received tyres are then stored and chipped. The chipping operation is performed by a specific tyre-chipping machine. The tyre chips are controlled for quality (specifically chip size) to ensure optimum consumption in the cement kilns. The chipped tyres are then transported to the main cement kilns in the UK.

Consumption of tyre chips in cement kilns

The cement works have allocated storage space for tyre chips as fuel. The process of introducing the fuel is a straight-forward, conveyor based system to feed the fuel into the kiln at a steady rate. The use of fuel in the kiln is tightly controlled through a central control room which monitors the performance parameters of the cement kiln. Kilns can consume whole or chipped tyres, but tyre chips are viewed as more efficient for both transportation, handling and consumption.

6.5.5 Relationship characteristics

The following table shows the main characteristics of the relationships in this case.

Table 6-7 Case One - Relationship characteristics

Characteristic	Michelin - Lafarge	Michelin – Sapphire
General	The attitude of Michelin is to develop a JV in each country with shares held by al the tyre manufacturers represented in that country (however, seen as monopolistic by European commission). To be responsible for the collect and proper disposal of all end of life tyres	Intermediate collects all Michelin franchise's tyres for Sapphire equivalent to all Michelin ELTS in UK No contracts with other collectors Potential for monopolistic process to be avoided, as one disposal route among many.
Specific investments	Equity in the joint venture (from Lafarge 75% share, Michelin 25% share) Members of the Sapphire board from Michelin and Lafarge No dedicated equipment, sites or personnel to Lafarge or Michelin from either party	No assets specific to Michelin Co-located to cement kilns so more difficult to switch to other end user Lafarge has tyre specific equipment and personnel, not Michelin specific
Certainty	Provided through the JV	Certainty maintained through the JV arrangement, sharing information about end user and tyre arisings
Dependence	Dependency through the JV structure Lafarge could switch back to unreliable supply of before Not an industry level initiative	Michelin dependent on Sapphire to provide take back solution, no alternative could take all the volume (would be more complex alternative)
Risk sharing	Through the JV	Through the JV
Duration	JV, open ended, running for 3 years so far	Joint venture, open ended agreement. Other contract on shorter notice (e.g. WTS)
Information sharing	Information on sales in the market and distribution network structure	Demand for tyres in kilns, quality requirements
R&D	NO specific input to or from design, not specific research activities as process pre-existing	Worked on chip quality for 3 years (but with Lafarge and not Michelin)
Reason for sourcing	Complementary skills, viable disposal route already established, capacity for all Michelin tyres	Sufficient capacity to deal with all Michelin tyres
Attitude to price changes	Agreed in JV negotiations, cost free to Michelin, minimise last user cost	Dealt with in JV arrangement, no costs to Michelin
Mode of governance	Joint venture arrangement	JV Other relationships with collectors, arms length
Complementary resources	Marketing and distribution power of Michelin Disposal route provided by Lafarge	Michelin – power over franchise retailers and marketing Sapphire - developed resources in JV, for collection, chipping, coordination of SC

The key relationship in this case study is between Michelin, the manufacturer of tyres and Lafarge the consumer of ELTs. In this case a joint venture company was set up between Michelin and Lafarge, named Sapphire to deal with the processing and organisation of the collection of ELTs and the delivery of ELTs or chipped tyres to the Lafarge owned cement kilns and in fact to other kilns of other cement manufacturers as well. The equity split between the two firms is 75% Lafarge ownership and 25% Michelin ownership. The board of Sapphire has 3 members from Lafarge and 1 from Michelin.

Specific assets

The main investment is in terms of capital for establishing the joint venture as well as time for board members of Sapphire. Clearly the investments from the Michelin's side are dedicated to Lafarge, and equally Lafarge's investment into the JV is specific to Michelin, through the joint equity split. However, further investments into assets such as sites and equipment are only dedicated at the level of the product, i.e. all brand tyres can be processed by Sapphire and Lafarge.

> *"I feel comfortable in the fact that I've taken that risk, as comfortable as you can when you are talking about millions of pounds, because Lafarge cement and the other cement manufacturers made their investments in authorisations and putting in the capital equipment again on the back of enormous risk and we've tried with the Michelin relationship, with the establishment of Sapphire we believe we've found a way of diminishing that risk, but that actually hasn't happened" Managing Director, Sapphire*

In order to gain sufficient volume for the chipping operation to be profitable, Michelin uses its relationship with the franchised tyre retailer (service centre) ATS to ensure that volume from these sources to collected and directed to the Sapphire processing plant (tyre chipping operation).

> When asked about why the risk has not reduced *"That's because of the fact that producer responsibility has not been applied to the retailer, but has been applied to the producer, and the retailer is only interested in money." Director, Michelin UK*
>
> This is limited to retailers that Michelin has influence over so instability still exists in the supply of ELTs.

Furthermore demand from the cement kilns is not predictable, leading to spot market type contracts with tyre collectors to allow some flexibility and control of ELT stocks.

"we've still got this erratic demand situation, and so it would probably be disadvantageous for us now to enter into solid contracts because we are there to provide a service to the industry, but we're there to provide a service to that industry on the back of what Lafarge cement can do, and if it hasn't got that stable platform, if I entered into 'take or pay' type contracts, or more solid contract I'd be shooting myself in the foot." Managing Director, Sapphire

6.5.6 Capabilities: pre-existing, acquired and developed

The following table lists the capabilities that were described as important to the implementation of the product recovery operations. These descriptions are linked to 2nd order level descriptions that were derived from the transcript analysis, whereby respondent statements were coded according to common types of capability (an example is shown in Appendix Four Examples from Qualitative analysis method using NVivo p.301).

Table 6-8 Case One - Capabilities

First order description of capabilities	**Second order description of capabilities**		
	Michelin	**Lafarge**	**Sapphire**
Ability to find recycling solutions	**Acquired:** Ability to develop measures and technologies to support product recovery	**Pre exist:** Ability to develop measures and technologies to support product recovery	**Developed:** Ability to develop measures and technologies to support product recovery
Ability to develop an acceptable recycling route	**Acquired:** Ability to develop measures and technologies to support product recovery	**Pre exist:** Ability to develop measures and technologies to support product recovery	-
Ability to develop product specific technologies	**Acquired:** Ability to develop measures and technologies to support product recovery	**Pre exist::** Ability to develop measures and technologies to support product recovery	-
Ability in waste management	-	**Pre exist:** Ability to develop measures and technologies to support product recovery	**Developed:**Ability to develop measures and technologies to support product recovery
Ability to meet environmental standards	**Acquired:** Ability to develop measures and technologies to support product recovery	**Pre exist::** Ability to develop measures and technologies to support product recovery	**Developed:** Ability to develop measures and technologies to support product recovery
Ability to gain environmental competence (waste management and management systems)	-	-	**Acquired:** Ability to control and coordinate the supply chain
Ability to have flexible supply strategy	-	-	**Acquired:** Ability to control and coordinate the supply chain
Ability to locate facilities closer to arising and 'customers'	-	-	**Developed** Ability to control and coordinate the supply chain

Ability to coordinate the supply chain or move up the supply chain	-	-	**Developed** Ability to control and coordinate the supply chain
Understanding of the tyre distribution market	**Pre exist::** Ability to control and coordinate the supply chain	-	**Acquired:** Ability to control and coordinate the supply chain
Ability to understand the market for product recovery	-	-	**Developed** Ability to control and coordinate the supply chain
Ability to coordinate the supply chain flexibly	-	-	**Developed** Ability to control and coordinate the supply chain
Ability to recruit expertise	**Acquired:** Ability to network to find expertise	-	-

The capabilities that were identified from the case data were codified into three categories: ability to develop measures and technologies to support product recovery; ability to control and coordinate the supply chain and the ability to network to find expertise. These are described next.

Ability to develop measures and technologies to support product recovery

Lafarge has developed significant expertise in the use of tyres in cement kilns. They have made significant investments to ensure that they are allowed to 'burn' tyres by the authorities, e.g. has the assets to consume the tyre in cement kilns to provide a 'waste free' solution to end of life tyres.

However within the joint venture they are having to develop competencies in new areas such as waste management

> *"its down to the management of sapphire to gain that knowledge, and understand it which I think we've done very effectively, to the extent now we are going for a waste management licence here, and people have gained the right level of competence, WAMITAB and COTCs to do that so we've got the Oldbury site operating under a waste management licence, we're soon to have one operate to the east of London which will operate under a waste management licence, so we're understanding all of this much better." Managing Director, Sapphire*

Hence this capability is both pre-existing and developed through the JV and expertise from Lafarge specifically has helped develop compliance measures

Ability to control and coordinate the supply chain

It was the original intention of Michelin to ensure that any company (or JV) dealing with ELTs has the right set of competences. The main competence in the view of both Michelin and Lafarge was the ability to understand, and gain advantage from the supply chain in terms of making supply of material more stable. For this to happen a knowledge of the market place is essential, how the collectors operate, the motivations of the retailers, the economics of re-treading tyres as opposed to disposing of them and such like. However, this ability was not acquired through the joint venture and had to be developed by the management team itself.

> *"It was also necessary to develop a knowledge of market place for used tyres" and "We now have a very good knowledge of the market place" Managing Director, Sapphire*

There was some input from Michelin on the structure of the distribution network, and a dictum from Michelin that their franchise outlets should use Sapphire as a final disposal route. Essentially then it was the combination of coercive power from Michelin and the development of supply knowledge by Sapphire that allowed the control and coordination of the supply of ELTs to Lafarge.

Ability to network to find expertise

The joint venture which has employed both personnel from Michelin and Lafarge to provide skills on the market side as well as technical skills in the use of tyres as an alternative fuel in the production of cement.

> *"There are two things........ we need people who are very much use to this waste management. That's one part because there are a lot of environmental issues about, so we need some experience that's clear. But we also need people that are very much aware of the tyre distribution, for a very simple reason which is that if we want to collect 100% of what is the total market you've got to go to the market. And there is only one way to go to the market and that is through the distribution chains, if not then just forget it, so that is really the key factor, absolutely the key factor." Michelin Vice President*

Thus certain skills are required and the ability to find those skills in the organisation is seen as important.

6.5.7 *Organisational benefits*

The following table derives the benefit from the product recovery operations across the relationships described earlier.

Table 6-9 Case One - Benefits

	First order description	Second order description
Eco Ben	• An ecological sound approach to recycling with multiple benefits • Multiple ecological benefits	**Solves multiple impacts**
	• Sufficient capacity to solve the UK tyre problem	**National scale of impacts**
	• Closed loop solution	**Closed loop**
Org Ben	• Gaining economies of scale	**Reduces cost**
	• More efficient logistical process for returns	**More efficient process**
	• Low cost solution for last owner	**Improves customer relationship**
	• Spreading capacity across multiple sites	**Improves flexibility**
	• Green company in charge of take back • A global approach	**Improves reputation**
	• Meet the legislation on landfill • Meet the government target to recycle tyres	**Compliance**
	• Creates supply stability (but not proven) • Reduces risk • Ineffective partnership (could be improved) • Coordinate the supply chain • Managed demand and supply	**Reduces risk**

The tyre manufacturer discharges his producer responsibility and pre-empts legislation in this area. However, there is no direct regulation on Michelin to put in place a system of take back for, and treatment of, end of life tyres. Thus this is a strategic level action, which Michelin undertakes in all selling markets in order to be prepared if future legislation does require actions. In the context of the UK, this system is charged on top of the price of a tyre and is basically cost neutral to Michelin. Michelin has an environmental policy that supports this approach. Reputational effects may be positive, but Michelin VP of ELT doubts whether customers care about the environmental credentials of the product when price is the main selling criteria.

> *"at the time that Michelin decided to come into sapphire, I think their belief and the belief of the tyre industry was that the onus of responsibility would be put at the retailer level, that hasn't happened and it doesn't look like happening and so their original reason for coming into it has become questionable since" Operations Manager, Sapphire*

The tyre reprocessor gains a fuel supply that is more stable. and allows a reduction in energy costs and a reduction in emission permit costs from cement kilns as the fuel has lower emissions. The investment in tyre chipping technology has led to transportation cost reduction, so costs of supply of units of fuel reduce.

The key benefit of the relationship is to provide knowledge and skills in the different areas required for the take back and processing of end of life tyres in an environmentally sound manner. In this case Michelin provide, through coercion, a channel of supply of end of life tyres that provides sufficient volume to make the joint venture a viable proposition. Additionally Michelin's knowledge of the distribution market was expected to benefit the marketing side of the joint venture. This guaranteed volume also provided sufficient stability for Lafarge to benefit from continuous supply of fuel that was less environmentally polluting, lowering the costs of compliance. Investment was put into the shredding of tyres which reduces the cost of transportation and make the use of tyre chips more available, a more efficient use of tyres in the combustion process.

The benefit of the relationship from the Michelin side was that the Lafarge kilns had sufficient capacity to deal with all of Michelins volume of end of life tyres, to completely reprocess all Michelin's for the UK. Lafarge also , through Blue circle had a great deal of experience in using tyres in kilns in a manner that produced emissions of a higher quality (less polluting) than other fuels that were used.

6.5.8 Ecological benefits

The ecological benefits of the tyre recovery system are that investments have been made in shredding equipment, which make transportation of the tyres more efficient. The relationship does not affect the performance of tyre use. When asking about the benefits ecologically the following is a typical answer.

> *"energy cost reduction, but also a benefit for the cement industry in reducing emissions. Through carbon trading and the climate change levy reasons, so it's much wider, it's fundamental, environmental improvement." MD Sapphire*

The main point is that the joint venture has allowed a system where all of one manufacturers end of life tyres (or the equivalent volume) are used in a perceived environmentally sound manner. The emissions from the Lafarge cement kilns have also been reduced because of a greater supply of shredded tyres.

A final set of findings are about legitimacy. Sapphire are trying to provide a service that builds legitimacy within the industry, but there are barriers to this, especially related to the operators that currently exist.

> *"and invariably the number that the driver collecting has put on, is probably going to be quite different from the number, because they can't count very well, I'm sure that's all it is, and so you've got, its very important actually, it stops the ability of somebody wishing to enter the collection business they cannot compete because of those elements" Operations Manager Sapphire*

The less professional section of the industry prevents the further legitimacy of the process.

Furthermore, using tyres in cement kilns is by no means agreed upon as the most ecologically sound approach, and therefore could actually have negative effects on reputation of the OEM. For example

> *"The Wiltshire Times Lafarge questionnaire has revealed a staggering 92.5 per cent of respondents are against the burning of tyres and Recycled Liquid Fuel at the cement works in Westbury with less than eight per cent in favour". (Wiltshire times UK Newsquest Regional Press - This is Wiltshire - July 23, 2003*

6.5.9 *Synthesis and conclusion*

The following figure represents the relationships between the studied concepts.

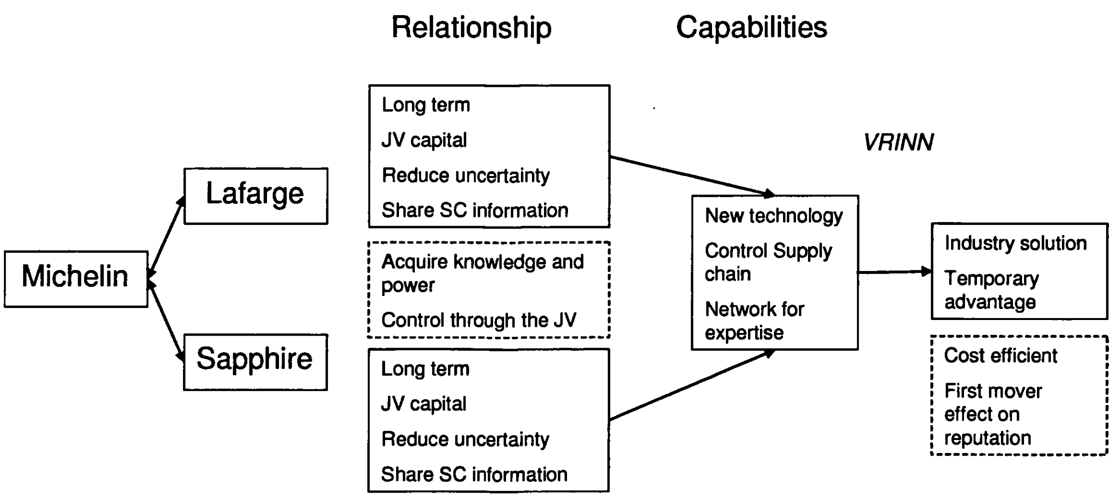


Figure 6-8 Links between the case one concepts

The relationship between Michelin, Lafarge and Sapphire shows many of the attributes of collaboration, and as a joint venture, by definition is a series of close ties through capital and the sharing of information and knowledge. The capabilities, for product recovery predominantly reside within Sapphire, the company specifically set up to coordinate the recovery of end of life tyres. However, these have been combined with the ability of Lafarge to provide an ecologically sound approach to recycling and Michelin's influence over the supply chain to ensure supply volume (if not stability). The competitive value to Michelin is in the area of reputation, typically difficult to quantify, and the strong public resistance to using tyres in cement kilns could mean this approach has a negative effect on reputation. The recovery process set up through the joint venture is being viewed as an industry solution, and eventually any benefits that accrue would be shared across multiple tyre OEMs.

6.6 Case Two: Copiers

6.6.1 Introduction

This case examines the relationship between Xerox and two contractors involved in the product recovery chain, Covertronic and Flextronics. Again the focus of the case was to explain two collaborative relationships that Xerox has developed for product recovery and examine the role of collaboration in the recovery operation.

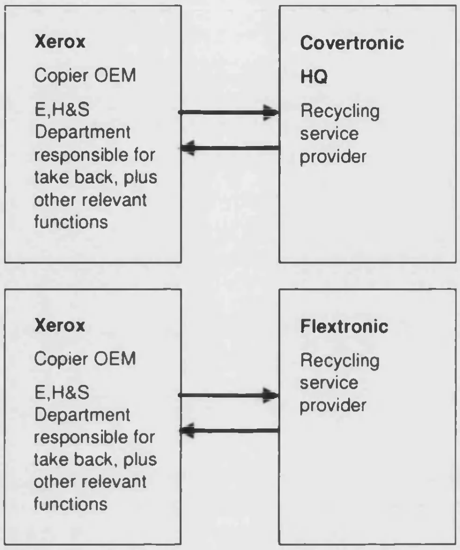


Figure 6-9 Scope of Case two- photocopiers

The case is based on an initial mapping study with Xerox personnel and then extensive interviews including site visits and examination of company documentation. Interviews were carried out with the Xerox HQ, asset recovery centre staff and staff at their Venray site in the Netherlands. These were supplemented by interviews with operations staff at the Covertronic and Flextronics sites. Furthermore, secondary interviews were used to provide contextual background to the case.

Table 6-10 Interview list for Case Two

Company	Function	Number
Xerox	EH&S Manager, Ops mgr, returns mgr	6
Covertronic	Operations mgr, business devt mgr	3
Flextronic	Ops mgr, business devt mgr, SC mgr	3
Secondary interviews		
HP	Environmental programs, Envt mgr	2
ReCommit	MD	1
Engelhardt	MD	1
Fujitsu	Envtl Policies	1
	Total	**17**

6.6.2 *Industry context*

Xerox Ltd employs 24,000 people and manufacturers and sells document processing products and services throughout Europe, Asia and Africa, which generates an annual revenue of around £3.5billion. The company is part of Xerox Corporation which is based in the United States and employs over 90,000 people worldwide with an annual revenue of over $18billion. Since 1993 Xerox has been structured as four business development units based on office document systems, office document products, document production systems and printing systems. These units have responsibility for development of product ranges and bringing them to the market. There are also seven regionally based customer business units, which are responsible for sales and service. There is a central corporate organisation, which has legal, financial quality, human resources and corporate communications functions. In the units, business processes are organised around target customer groups rather than specialised functions.

Xerox was one of the first western corporations to use total quality management (TQM) and its competitive success owes much to its adoption as a strategic approach for managing, as it was used proactively to transform Xerox from a product led organisation, based on separate technologies, to one driven by service and customer problem solving. In the first instance, TQM was adopted as a response to a 'crisis of survival', in the face of challenges from the Japanese manufacturers, such as Canon. During the 1970s Xerox's rate of return on assets had been stable in the region of 20 per cent. After 1980 this declined every year to a low of less than five per cent in 1984. TQM was implemented at this time, and the rate of return rose to ten per cent and for 1997 achieved 18 per cent. Xerox's business processes have been some of the most innovative in modern business management and have included pioneering initiatives such as self-directed and multi-skilled work groups, benchmarking and self-assessment audits (Palermo and Watson 1993). Xerox Limited was also the first company to win the European Quality Award. Xerox is also well known for environmental initiatives in general and product recycling activities in particular (Maslennikova and Foley 2000; McIntyre et al. 1998).

The Asset Recovery Centre (ARC) was set up after the curtailment of manufacturing operations at Xerox's Mitcheldean site in the South-West of the UK. Xerox has undergone significant restructuring in the past decade leading to the divestment of the majority of manufacturing operations globally (for example plants in Toronto, Mexico, Malaysia and Holland sold to Flextronics). Xerox has also outsourced some of its asset recovery in the Netherlands to Flextronics. This is basically the same operation, the same site and the same employees, under a different owner. This divestment was implemented in 2001. The ARC site employs 250 people on site. Between 60-70 people work on refurbishment at any one time. In 2002 the site handled 39,000 units for refurbishment or recycling. The only other site for asset recovery is Dundalk in Ireland refurbish large printing machines, under a different business unit.

Covertronic

Covertronic are part of the AGR Group based in the town of Herton, in the Ruhr Germany. Employing 3000 people, the AGR group has dealt with all aspects of waste electrical and electronic equipment (WEEE) for the past ten years. Specifically they have dealt with community waste such as TVs and fridges (having set up a waste compliance scheme in Scotland for fridges). AGR also controls OmniCo that deals with waste computer recovery.

Covertronic, also based in Germany, employs 200 people and deals primarily with the resale of equipment. Covertronic operates in the UK from Glasgow, Scotland and has been doing so for the last seven years, primarily as a trading operation for WEEE. They operate turnkey projects, such as the fridge recovery operation in Glasgow. The recycling operation for Xerox is the first commercial UK project they have run, starting in July 2003. At the Mitcheldean site, Covertronic employ 8 people, only dealing with the copier stock. The site is run by one Covertronic manager.

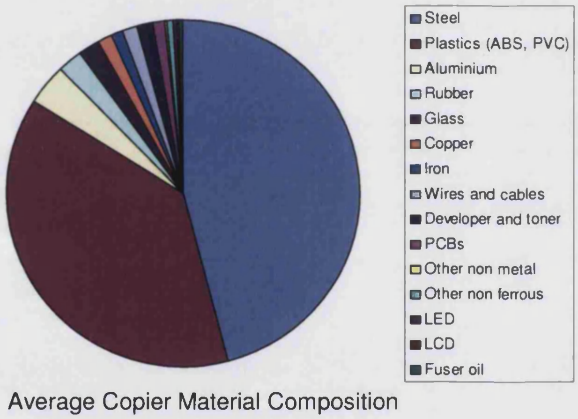
Flextronics

Flextronics International Ltd. is a large provider of advanced electronics manufacturing services (EMS) to original equipment manufacturers (OEMs) of products including handheld devices such as cellular phones and personal digital assistants; computer and office automation products such as copiers, scanners, graphics cards, desktop and notebook computers, and peripheral devices such as printers and projectors. They also manufacture home entertainment equipment, cameras and home appliances; and information technology infrastructure products such as servers, workstations, storage systems, mainframes, hubs and routers.

The company is one of the world's largest contract electronics manufacturers, employing 92,000 people globally[30]. In 2005, it had a total manufacturing capacity of approximately 12.8 million square feet in over 30 countries across five continents. The company has established an extensive network of manufacturing facilities in the world's major electronics markets (Asia, Europe and the Americas) in order to serve the growing outsourcing needs of both multinational and regional OEMs.

The company provides a full range of vertically-integrated global supply chain services through which it designs, builds and ships a completely packaged product for its OEM customers. The company's customers include: Alcatel SA; Casio Computer Co., Ltd.; Dell Computer Corporation; Ericsson Telecom AB; Hewlett-Packard Company; Microsoft Corporation; Motorola, Inc.; Nortel Networks Limited; Siemens AG; Sony-Ericsson; Telia Companies; and Xerox Corporation.

Product Characteristics



Total Xerox copiers returned per year	**39,000**
Number of product components	**c.1000**

Figure 6-10 Product Characteristics of returned copiers (Source: Kerr 2000, Xerox)

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[30] http://web.lexis-nexis.com/executive/ The McGraw-Hill Companies, Inc.Standard & Poor's Corporate Descriptions plus News **October** 15, Copyright 2005

6.6.3 Drivers

Table 6-11 Case Two - Drivers

1st order coding of drivers	Second order categories
Meet green expectations of customers Customer driven Reduce cost to customers of disposal Improving customer service Improve / maintain customer relationship Meet customer expectations	Competitiveness – customer expectation
Provide guarantees that free take back is possible in the future Uncertainty over new regulations Reduce disruption to existing process Impact of regulation on current processes	Competitiveness – reduce impact of legislation
Meet legislation Meet legislation with current system Meet regulatory recycling targets	Legitimacy – meet legislation
Threat of new legislation	Legitimacy – pre-empt new legislation

The main driver for refurbishment of copiers is to maintain the customer relationship from a service perspective. To a lesser extent Xerox is driven by legislation and the threat of new legislation in this area, particularly from the European side. There is a perception at Xerox that it is possible that new regulations will be disruptive to the current systems for taking back products from customers and recovering them.

> *"there are no obligations to take back consumables, of course customers are asking for it , but there are no legal obligations that we need to take back the material , of course that will develop over time, that will come at some point in time" Environmental Manager, Xerox*

Xerox also have a core global product standard, part of the company policy, to ensure the suitable take back or recovery of end of life products and to design them in such a way as to minimise the effects at the end of a product's life. This is a joint global standard with Fuji - Xerox (although does not specifically apply to Japan or Oceania). Both these aspects lead to the goals of profit maximisation and meeting legal requirements. In future the activities carried out at Mitcheldean and Venray will have to meet the requirements of WEEE which is believed to be possible with plans for the existing system.

6.6.4 *Operations*

Table 6-12 Case Two - Operations in the Copier Industry

	Collection Transport	Sorting Assessment	Depoilution dismantling	Repair Refurb Reman	Recycle Reuse
Xerox	-	Sort and Assess Machines	Both	All	Reuse some components
Covertronic	-	Assess components	Dismantle machines and components	-	Recycle plastics
Flextronics	-	Sort and Assess Consumables	Both	All	-

The organisation of product recovery is coordinated through the European Fulfilment Operation which is basically a photocopier supply organisation operating at the European level. The Service Supply Chain is also an organisation involved with this, focusing on parts and consumables. Through this organisation Xerox brings back parts for servicing and if they are classified as end of life they can be brought back in to the asset recovery centre. Of the 39,000 copiers that were processed in 2002, 25% were refurbished and resold, 25% were used as 'donors' of parts for refurbished machines or as service parts and 50% sent as scrap (parts re-use, recycling or disposal).

Copier collection

TNT (a logistics service provider) collect the copiers from customer sites, handling approximately 100 machines a day, and returns them back through the UK distribution centre at Mitcheldean. The machines are distributed overnight and in 2003 these comprised of 70% new machines and 30% 'ARC Refurbished' machines to customers.

TNT collect direct from the customer sites, through to a consolidation centre and then the machines arrive at Mitcheldean in the morning. These consolidation centres, of which there are four, are all dedicated to Xerox. TNT carry out some simple sorting based on the condition of the product of the machines using a database provided by Xerox, which is maintained by the Xerox Operating Companies (the companies that manage the customer contracts, sales or leasing). Therefore TNT are able to identify which machines have to be sent straight to Covertronic for material recycling and which go to the Asset Recovery centre (ARC) for refurbishment. TNT also carry out a simple disable operation to prevent the machines from being sold into the market again. Spare parts returns (Over orders etc) are returned to a Midlands depot and then returned to Mitcheldean and split between serviceable (which then go to Venray) and unserviceable which are scrapped. Commenting on the difficulties of the reverse supply chain, one manager said:

> *"I would say that the reverse one is even more complex" Manager, Asset Recovery Xerox*

Copier refurbish operations at Xerox

Sorting and stripping

As mentioned the machines are assessed by the 'Ops Cos' and then released to TNT who carry out a preliminary sorting operation to identify non-refurbishable copiers. TNT input information on the quality of the product into a shared database, identifying whether the copier is suitable for resale, repair, or material recovery. There are four categories that are used: 1) Return to customers; 2) High value parts can be re-used or the machine refurbished; 3) Some of the parts can be re-used and are stripped out; 4) The machine has reached its end of life and has to be scrapped.

Categories 2 and 3 are received at the ARC goods in and classified as carcasses. Category 4 machines pass straight to Covertronic. This procedure also applies to spare parts and then are returned to Venray, Holland for repair or refurbishment. The components are stripped out of the copiers and cleaned. The systems are completely stripped to the main frame. The components are then stripped out and cleaned. They use a CO2 spray to clean the parts and decontaminate them, mainly from toner.

Refurbishment

During the refurbishment process the machines are rebuilt using new and reprocessed parts. The frame is then 're-skinned' using new plastic panels. At this point the machines are not customised to individual customer needs and are standardised. These standard machines can then be matched to customer orders and configured according to the needs of that customer, for example adding country specific options such as power supplies. Other options can also be added and the software upgraded to the most recent versions. The machines are then subjected to the usual quality and electrical safety tests.

Recovery operations by Covertronic

The parts or whole machines that need to be recycled (scrapped) are sent to Covertronic, who share the site (by leasing their site from the same landlord of the business park).

The main process for recycling of copier scrap has been detailed by Xerox and Covertronic as shown in the following diagram

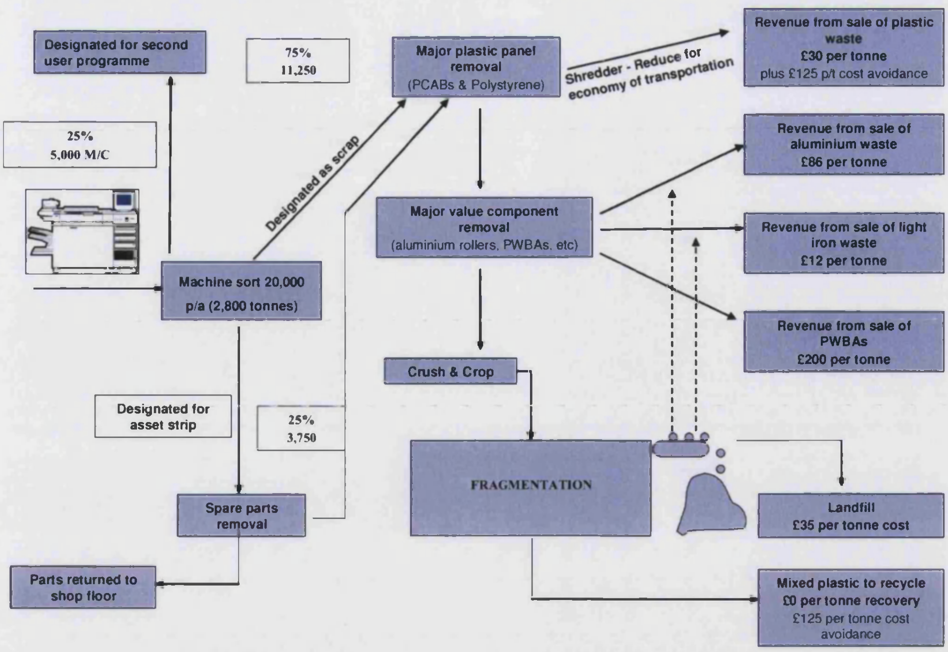


Figure 6-11 Recycling process at Xerox UK (Source Xerox 2003)

Covertronic log a mass balance weighing each of the machines at various stages. They basically assemble loads for scrap. The operation is a manual disassembly process, with very few specific tools. The cost effectiveness of this operation depends on the metal and plastic revenues as shown in Figure 6-11. The breakdown of the material that is produced is as follows: Metal as light iron is 90% of the output; PCBs; Cables; Low grade electrical, power assemblies, hard disks; Miscellaneous such as aluminium; Plastic of three types, ABS, PC ABS and ABS fire retardant. For ABS plastic they reach 98% recycling.

The ABS plastic is delivered to a granulation site (co-located). The plastics form a 'nearly' closed loop process using about 20T a month which accounts for about 5-10% of the total amount needed for the production of new plastic for copier machines.

Operations by Flextronics, Venray

This operation concentrates on remanufacturing spare parts and consumables, as at present there are no machine returns. The decision on whether to remanufacture a part or machine is based on a case by case analysis that includes economic and environmental arguments, as illustrated in the following quote:

> *"we remanufacture them if we have the returns, so we can market a reman programme and for spare parts we have a number of spare parts that can be repaired and we have sufficient economic volumes to return those in an*

economically acceptable way, or that we do it for environmental purposes..., so we reuse toner as raw material and also we are reusing toner bottles and if you look at and when you look at toner bottles it is even cheaper to blow new bottles but in this case for environmental reasons we also are reusing the ones that we are getting back." Asset Returns Manager Flextronics

The manufacturing and remanufacturing processes are fully outsourced to Flextronics and follow the same process as in the ARC, Mitcheldean, UK.

6.6.5 *Relationship characteristics*

Table 6-13 Case Two - Relationship characteristics

Characteristic	Xerox - Covertronic	Xerox - Flextronic
General	Viewed as a partnership arrangement with transparency in information sharing Ventures to deal with recycling don't always work	Part of the general manufacturing outsourcing strategy of Xerox, remanufacturing part of the operations outsourced
Specific investments	Dedicated site and personnel to Xerox for dismantling and recycling Xerox has own assets for remanufacturing IT industry often keeps value added 'asset recovery' in house	Bought all Xerox manufacturing assets in Venray (site, equipment and personnel)
Certainty	Revenue uncertain due to materials markets, supply side certain due to in house processes Share demand information	Certainty that Flextronics can continue the business profitably
Dependence	Only one contractor for dismantling, but could do in house	One main contract manufacturer in Europe. Other contractor globally. High dependence
Risk sharing	Share revenues (but not losses)	Flexible contract terms
Duration	1 year rolling contract, lasting 2 years so far	Contract with Flextronics for 5 years (likely to continue)
Information sharing	transparent materials balance information	materials balance, recycling levels
R&D	Minimal Feedback into R&D	No specific R&D in Flextronics for Xerox but linked to Xerox R&D facilities
Knowledge sharing	Based on developed capabilities over time	Took over all site personnel so transfers skills and knowledge
Capacity planning	Capacity planning carried out jointly	Use the same demand forecast system (shared DRP system)
Reason for sourcing	Could offer a turnkey solution	Global player in contract manufacturing
Attitude to price changes	Based on costs of business, shared with Xerox	Annual renegotiations
Modes of governance	Contractually based, but with weekly site meetings and shared information systems	Long term contract, based on open book arrangements (transparent material flow information for recycling targets etc)
Complementary	Xerox holds detailed knowledge	experience in contract

resources	about the machines and how to dismantle them, Covertronic are able to efficiently trade materials and parts in vendor network	manufacturing little experience in remanufacturing but wish to acquire this capability

Xerox integrated operations - asset recovery centre

Xerox took a strategic decision to integrate the activity of refurbishment and remanufacturing in order to control the quality of the product that is sent back into the market. Xerox claim that refurbished copiers are of the same overall quality as new machines and do not differentiate them to the customer (could be classified as remanufactured machines). Therefore the quality is required to be same. They state that they have the capabilities to manufacture the machines and therefore are in a good position to have the knowledge to refurbish them to the same standard. However it could be argued that this is being lost through the divestment of most of the manufacturing operations to third parties in low costs countries. They also control the supply of used machines, through the 'Ops Cos' and have the established distribution channel to sell the refurbished machines into through the concessionaires.

The main other relationship that Xerox ARC has is with the company that recycles the copier scrap, either whole machines or parts stripped in the ARC refurbishment process.

Xerox - Covertronic relationship

The Covertronic operation is dedicated to Xerox through the site and personnel and leads to a certain a amount of dependency for this reason. Xerox has no other recycling provider for the ARC site. To counter potential opportunism the relationship is characterised by high levels of information and knowledge sharing from Xerox. There is complementarity in the resources in that Xerox controls the supply of copiers and has detailed design knowledge, whereas Covertronic is able to offset the cost of recovery through its established network of components buyers. One of the key aspects of this relationship is the transparency in the operation, where Covertronic share all the profits from re-sale of parts and scrap with Xerox. In order to do this Covertronic operate an open book system with Xerox to show both the mass balance of materials recycled (for legislation compliance purposes, for example anticipating WEEE legislation) and revenue information on the sale of materials and costs of disposal.

Xerox – Flextronics

There are significant specific assets that Flextronics has invested in relating to the site, equipment and personnel.

> *"Flextronics is really a partner behind the scenes. Most people don't know Flextronics as they are not marketed but they are a very big player in the market. What they basically did, they bought the manufacturing operation from Xerox and there were significant amounts of money involved in that" Operations Manager Flextronics*

This means that the dependency between Flextronics and Xerox is related to the specific nature of their contract, and high value transactions. In particular, Xerox relies on Flextronics for European consumable manufacturing and remanufacturing, and the Flextronic site is dependent on Xerox sales and distribution. The style of governance gives Xerox managers some confidence that Flextronics fulfil their side of the bargain by meeting agreed targets and sharing information system and operating an open book style of accounting:

> *"we have a contract for 5 years or so and in fact we are looking at open book and if they are making losses, that you can't predict when you are taking over such a big company in half a year, so there is open book accounting and we are discussing the plusses and the minuses. If it deviates from the standards that we have set for them and that goes into a partnership approach and it's working quite well." Operations Manager Flextronics*

The reason for contracting was made clear in the following comment:

> *"the advantage of working with a partners that first of all you do not have the fixed costs in your organisation so if the market is going up or down, Flextronics has more markets and customers to sell to so they are more able to cope with that (smooth demand with different contracts), also they have more facilities and more countries plus their core competence is manufacturing, whereas our core competence is marketing, is design" Xerox Supply Chain Manager*

Furthermore the sharing of information is basically at the level of an internal function as the quote below suggests:

> *"Yes we have EDI links and sometimes we work on the same infrastructure , in this case we are getting EDI calls, but for some products we are also sending complete files of information via FTP or whatever , there's a lot of exchange of information, there's only one barrier of course , there are firewalls between our*

organisation and the Flextronics and of course we are not sharing finance information any more , and some technological information from suppliers there are some restrictions that we didn't have in the past and that makes it a bit more complex because they need to ask and we need give and they don't get the complete information" Xerox Manager Venray

There are risks that the contractor could be opportunistic based on the level of dependency, but the level of collaboration tends to out weigh that (plus the fact that such a large customer base prevents Flextronics from damaging its reputation). The risk from legislation may mean that processes have to be redesigned, questions if Flextronics are ready to do this

"if sometimes you look at the development of legislation, of course they have to take into account all the infrastructure in Europe and some countries might not have those developed processes there are sometimes some barriers in there that could make the technological developments more difficult," Environmental Manager Xerox

Risks are also reduced by the auditing process implemented by Xerox to ensure standards are adhered to, as suggested below.

"We audit Flextronics and Flextronics audits the subcontractors so that we have the full information , so they have a reporting system by waste category and they are reporting how much they send to which suppliers so we can monitor to which suppliers the material goes, we can monitor the performance of the flow so all the information is available to check to see if it is fulfilling our targets," Asset Recovery Manager Xerox

6.6.6 Capabilities: pre-existing, acquired and developed

The following table details the first and second order description of the capabilities developed for product recovery in this case. The table details where the capabilities reside (OEm or contractor) and if they are pre-exists, acquired or developed through the relationship.

Table 6-14 Case Two - Capabilities

First order description	Second order description		
	Covertronic	**Flextronics**	**Xerox**
Ability to have a relationship with end users of end of life products Ability to work with suppliers to gain environmental competence Ability to control subcontractors systems through audit Ability to gain economies of scale in material supply Ability to control the destination of re-used / recycled products Ability to coordinate the supply chain Understand the market place Control of distribution channels Ability to combine returns into the traditional distribution process	**Pre-exist:** Control and coordinate the supply chain	**Acquired & Developed:** Control and coordinate the supply chain	**Pre-exist:** Control and coordinate the supply chain
Ability to influence design for recycling / remanufacturing Develop a role in component design Ability in marketing and design Ability to develop recycled content programs	**Developed:** Influence design for product recovery	**Acquired:**Influence design for product recovery	**Pre-exist:** Influence design for product recovery
A history of remanufacturing Development of remanufacturing processes and networks over time Desire to develop remanufacturing capability	-	**Acquired:**Build up processes over time	**Pre-exist:** Build up processes over time
Ability to hold information about a products life Ability to categorise End of life products Ability to develop new technologies for recycling The development of targets Ability to implement a simple returns process Ability to flexibly adopt practices Ability to remove barriers to recycling / remanufacturing Ability to take the environment into account	**Pre exist & Developed:** Introduce measures and technologies for product recovery	**Acquired:** Introduce measures and technologies for product recovery	**Pre-exist:** Introduce measures and technologies for product recovery
Ability to influence legislation	-	-	**Pre-exist:** Ability to influence legislation
Ability to influence customers to return product, appeal to their social concerns Ability to market a service to customers Ability to share returns value to customers Ability to develop a customer service Ability to use the customer relationship to support the returns process Ability to assure customer reputation	**Pre-exist:** Create a customer focused program	**Acquired:** Create a customer focused program	**Pre-exist:** Create a customer focused program
Develop a market based approach, brokerage Ability to use negotiating power Ability to transfer assets and capabilities to contractors	***Pre-exist:*** Use position in the supplier chain	-	***Pre-exist:*** Use position in the supplier chain

Control and coordinate the supply chain

Within Xerox there is a large amount of experience of the market place of the product and the means of control of the channels to the market e.g. the logistics operations are part of the European Fulfilment Operation although it is contracted out to a third party [TNT]. This is especially important in product recovery where acquisition is often one of the key barriers to success. Covertronic had pre-existing supply chain links and further developed this to locate viable markets or scrap parts and material in order to reduce the overall cost of recovery. Flextronics have acquired the part of this process that interfaces with manufacturing, but much of this capability is still held by Xerox.

Introduce measures and technologies for product recovery

Xerox are also in a good position to be able to categorise the products with relation to the level of recovery needed. The company (through the Ops Cos) holds records and histories of all the equipment leased through the operating companies. This information could also be seen as a resource as there is knowledge of exactly where the products are. This is the advantage of leasing products, where there is a database of customers and condition of machines.

A reduction in the number and the variety of materials has also taken place through design. This has come about through the improvements in plastics performance. To a degree this has also simplified products for both assembly and disassembly. The manufacturing knowledge and routines (TQM) has allowed a remanufacturing programme that means 'as new' quality standard and provides a lean manufacturing process with aspects of agile manufacturing (post-poning configuration until the customer order is received). Flextronics have acquired this capability. Covertronic have developed with Xerox measures for recovery (recycling targets), but this is essentially a low technology approach.

Influence design for product recovery

Xerox also has the design capabilities to make recycling or refurbishment operate economically. There has been a major reduction in the development cycle time driven by new technologies e.g. digital technologies and through the integration of functions. This has allowed new technologies that facilitate upgrading, refurbishment and recycling. The design phase ensures that it is possible to re-use components in the next generation of machines so that these components are not designed out or do not become obsolete. For example, new Silver Stone machines can use parts of the older Hodaka series through the use of design. Neither Flextronics nor Covertronic have direct input into design, although Xerox has design engineers present at the Flextronics site on a regular basis.

Build up processes over time

With respect to Covertronic, the main capabilities that are brought in relate to gaining revenue from selling scrap and minimising the costs of disposal. In this case the skills required for disassembly can be thought of as routine and do not offer differentiation. However, for Xerox to develop a market understanding of the material and electronics parts spot markets, would require significant investment in training or recruitment of this resource from outside the firm. Either way, this would entail significant cost in an area that is not seen as a core competence (with most revenue coming from the sale of refurbished machines). As Covertronic already have an established network of relationships for selling and disposing of electronic scrap that they have built up over time, particularly with the link to their German parent company, which explains Xerox's choice of partner. With Germany leading waste regulation across Europe it may be expected that there is a transfer of knowledge about advance recovery operations from the parent company to the UK arm of Covertronic.

The relationship with Flextronics questions the reliance of Xerox on manufacturing capabilities to find advantage in disassembly and refurbishment operations. While Xerox retains the design know-how for new copiers, the manufacturing capabilities developed since the 1970s, especially the implementation of TQM as an example, may now be eroded. As the site at Venray is now capable of manufacturing and refurbishing copiers, the competitive advantage of internalising refurbishment capabilities could now be questioned. The continued divestment of manufacturing and 're-manufacturing' is likely through outsourcing, assuming Xerox can maintain the quality and service levels it is known for. In fact Flextronics were specifically interested to develop this part of the business as the quote below supports:

> *"it was one of the interesting parts for Flextronics to take over because they didn't have the infrastructure and now this is growing for reman and repair and for environmentally sound disposal and we have legislation coming along with the WEEE and ROHS directive, so its something that Flextronics is interested to build and build further on" Asset Recovery Manager Xerox*

Create a customer focused program

The special capabilities that Xerox brings to the recovery of products relate to the relationships that they have with their customers, that they maintain throughout the life of the product. This is a rare relationship with customers with regard to office machines. Neither Flextronics not Covertronic are able to influence this part of the supply chain.

Use position in the supplier chain

The broader perspective of business to business returns indicates that the ability to use negotiating power and obtaining economies of scale are important in receiving revenues from recycled materials. In particular Xerox has been able to set up processes that make product recovery economical, precisely because they control the acquisition of the product through their leasing and service agreements with customers.

6.6.7 Benefits

The benefits of Xerox's strategy to internalise refurbishment and outsource recycling can be summarised in the following table

Table 6-15 Case Two - Benefits

Type of benefit	First order description	Second order description
Eco ben	Including recycled material in new products Reuse materials in manufacturing	**Closed loop**
	Recycling materials (process) Recycling materials (product) Achieving high recycling targets	**High level of recycling**
Org ben	Revenues from remanufacturing	**Increases revenues**
	More capacity flexibility in remanufacturing	**Improves flexibility**
	Cost effective operation through material revenues Cost avoidance (landfill costs) Cost effective returns process Closed loop supply chain for toner Cost avoidance (landfill and incineration costs)	**Reduces costs**
	Low administration process (lean)	**Lean process**
	Corporate PR benefit of recycling	**Improves reputation**

Organisational benefits

The organisational benefits for Xerox, of the relationships that it set up centre round the ability to maintain value added activities such as design and close customer links, while at the same time divest certain operations that support its broader aim to provide extended customer service including green product services (recovery). The relationships have enabled a maximisation of revenues to balance the cost of recycling parts and materials and even reduce material costs in some cases.

Increases revenues

Xerox has been able to establish a new market for refurbished machines. This increases the market share for Xerox and offers the opportunity to identify new customers. Xerox has also introduced new revenue from scrap, a revenue stream is now available from the sale of electronics scrap (parts and components such as hard drives).

Reduces costs

By contracting operations relating to recycling in the case of Covertronic, there was an associated reduction in material disposal costs. This was due to the re-negotiation of disposal contracts through the new recycling partner and the recycling of materials which would normally have been landfilled, leading to a reduction in disposal costs.

Furthermore Xerox also saw a small reduction in material costs. Through the work with Covertronic new materials for copiers were developed using of recycled ABS from scrapped copiers. This reduces the cost of new ABS material (this advantage is dependent on the volatility of materials markets and associated pricing).

Improves flexibility

The introduction of the contracted recycling service providers and outsourcing manufacturing has meant that flexibility is improved. In the case of Covertronic, their experience of dealing with electronic waste allows them to react to changes in the market quickly and to find suitable routes for recycling materials.

Flextronics on the other hand is able to take on complete Xerox operations, on a much larger scale and can introduce flexibility across a large capacity base, which better suits large scale remanufacturing.

Lean process

The in-house processes of Xerox have allowed them to develop lean systems for returns often removing many of the barriers to product recovery related to administration process and paperwork. These processes have been effectively transferred to Flextronics through the transfer of employees from Xerox. The co-location of Covertronic was also thought to allow some limited transfer of this knowledge about processes.

Improves reputation

Xerox has carried out some benchmarking in the area of environmental performance including recycling and Xerox think that they are ahead on many of the issues. One organisational benefit may be to appeal to new customers from who 'green procurement' is important such as government departments. The actual impact on public image and reputation is difficult to assess but managers believed that increasing their recycling levels, for example through the Covertronic partnership has a positive impact on public perception of the company.

The levels of recycling and remanufacturing at both contractors help Xerox meet their expected legal requirements. The current operations at Mitcheldean and Venray are believed to support compliance with the WEEE Directive leading to cost avoidance in non-compliance to this new directive.

Ecological benefits

One of the core benefits of the process being examined here is the opportunity for closed loop cycles whereby waste materials are used in new products, with the double benefit of reducing waste and reducing use of raw materials. A second point is the high level of re-use and recycling of machines and consumables produced by Xerox, through the contracted operations the levels of recycling are able to reach relatively high levels, with the ultimate aim to achieve zero waste factories.

- Reduction in landfill – of the machines returned over 75% are either re-used or recycled (by weight)
- Reduction in raw material use - for example Xerox has developed a closed loop system now where the plastic produced by ARC is used on an air intake on a new machine using ABS from the Hodakar series. There is also an example of ABS from copiers being used in indicator lenses for some Volkswagen cars.

6.6.8 Synthesis and conclusion

The following figure shows the relationship between the concepts studied in this case.

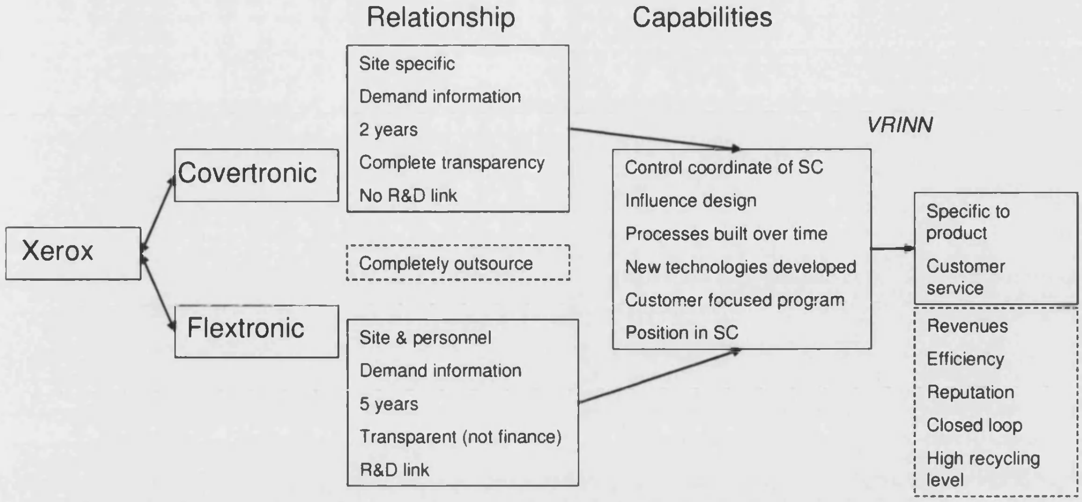


Figure 6-12 Links between case two concepts

Both long term collaborative relationships with extensive information and knowledge sharing counter the problems of dependency and maximise the use and development of capabilities. The capabilities have traditionally resided in Xerox, but now have partially been transferred to Flextronics through a significant outsourcing strategy. Covertronic offers further additional capabilities that allow revenues from scrap parts and materials to offset the cost of meeting high recycling level targets, which will ultimately meet new legislative requirements. The collaborative nature maximises revenues, reduces cost and bolsters reputation by controlling and coordinating the end markets for remanufactured and recycled machines, parts and materials

6.7 Case Three: Automobiles

6.7.1 Introduction

This case describes the end of life vehicle take back system in the UK and focuses on the relationship between one OEM, Vauxhall (part of General Motors Europe) and two vehicle recycling service providers: Autogreen and Bridges Salvage. The original intention of the case was to examine the relationship between the OEM and recycling service providers in the same position in the value chain. However, the recent organisation of vehicle take back in the UK has meant that OEMs will have one central contract with a vehicle take back service provider (in this case Autogreen), who then subcontracts to a network of recyclers (vehicle salvage yards) on the OEM's behalf. To maintain the scope of the case, one of the subcontract vehicle recyclers was also examined, although the direct link to the OEM is less well defined.

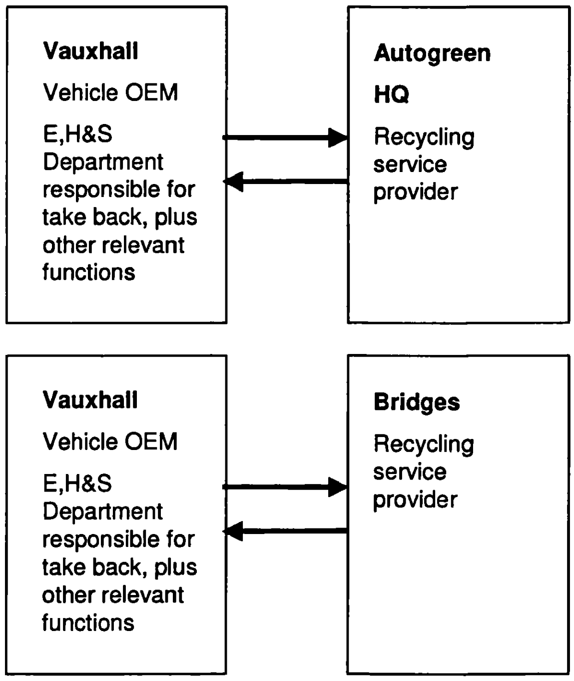


Figure 6-13 Scope of case three - Automobiles

As with the other cases presented in this chapter, this case is based on initial mapping activity to identify the relationships, site visits and extensive interviews both primary (concerning the relationships themselves) and secondary to gain broader contextual viewpoints.

Table 6-16 Interview list for Case Three

Organisation	Position	No Interviews
Vauxhall	Take back manager, Envtl Policies Mgr, Envtl Mgr	7
Autogreen	Managing Director, Operations Manager	3
Bridges	MD	2
Secondary		
5 other OEMs	Chief Engineer, Envt Manager, Chief design	6
EMR & ARN	Managers	3
DTI, CARE and SMMT	Automotive Managers	3
	Total	**21**

6.7.2 Industry Context

The following section provides a background to the end of life vehicle issue in the UK automotive industry.

General Motors Corporation designs, builds and markets cars and trucks worldwide. The majority of the company's business is derived from its automotive and communications services operations, the company also has financing and insurance operations. The company participates in the automotive industry through the activities of its automotive business operating segment General Motors Automotive (GMA) which is comprised of four regions: GM North America, GM Europe, GM Latin America/Africa/Mid-East, and GM Asia Pacific. General Motors Europe (GME) operates manufacturing sites in Continental Europe and the UK. GME sells GM brand vehicles in the UK such as Vauxhall, Opel, Saab, Chevrolet (prev. Daewoo). GME is responsible for providing a free take back service for last users of their brand vehicles from January 2006 under the EU ELV Directive.

Autogreen – set up as contact point for customer and data management and possibly accruals. The main services offered by Autogreen are a manufacturer approved take back facility network, issuing of COD (Certificate of destruction) to last owners, customer call centre, facility locator through their website, a data collection service, waste and collection service, site auditing, staff training and achievement of the recycling and reuse targets.

Bridges – purely a vehicle salvage site, which has recently invested in meeting regulations and depollution equipment to meet new requirements.

The aim of the ELV directive is to reduce the amount of automotive waste going to landfill. In the UK this currently equates to over 400,000 tonnes of automotive shredder residue (the left over from the car shredding process). The UK has around 2.6 million

ELVs each year. The legislation states that 80% of all the vehicle weight must be re-used or recycled, plus 5% can be recovered through energy generation, meaning that overall 85% of the vehicle weight must be recovered, to be achieved by January 2006. This will be increased to 95% by 2015. Furthermore the legislation requires that salvage yards must meet new environmental regulations (named authorised treatment facilities - ATF), the manufacturers must demonstrate a take back network for last owners (within 10 miles for 75% of owners and 30 miles for the rest). The manufacturers must pay for the 'free-to-last-user' take back of vehicles and resulting depollution costs (not including collection). The key challenge is the recycling of non metallic parts such as fluids, rubber, glass, plastic and foam (metallic parts are typically separated at the shredding phase and sold on the metals markets). Around 25% of the vehicle weight tends to be non metallic so called ASR – automotive shredder residue), of which 26% are thermoplastics, 20% rubber seals, 19% glass, 19% tyres, 9% seat foam, 2% battery, 2% fluids and fuel 1% thermosets and a further 2% of other materials. The legislation also states that vehicles must be depolluted and this means removing all fluids, tyres, air conditioning gas, batteries, air bags, oil filters, lead wheel weights and mercury switches. This requirement is a peculiarity to Europe at present, even though vehicle manufacturers sell cars to most global market regions as emphasised in the following statement:

"it's really only in Japan and in Europe that we are looking at this sort of activity. We are having to drag the American's screaming into this operation, for their viewpoint they have got plenty of holes in the ground to throw this stuff in, I wouldn't say they don't care but the legislative issues are some years behind Europe and Japan. Japan are almost running in parallel with us although their laws are somewhat different. Their laws are primarily aimed at reducing the hazard of the shredder residue because they've got serious landfill issues like there is no space for landfill." OEM manager 2

Furthermore, OEMs have integrated recycling issues into their environmental policies for a number of years.

"one is our global environmental policy statement which was initiated back in '94 which clearly gives a policy direction in terms of our responsibility to global environmental issues, which says basically we have responsibility for the products we make and sell in terms of a life cycle analysis and that's really there for considering the product from design, manufacture, use and end of life and

therefore try to maximise the sustainability issues within that life cycle" OEM manager 2

The transposition of the European ELV Directive into UK law has been a long process involving a series of consultations with multiple stakeholders, aimed at lessening the impact on the current infrastructure and UK business interests. As the following statement suggests, during the development process a large number of stakeholders were involved in bringing a workable set of regulatory requirements.

> *"We've been working in the background with service providers, so have some of the other manufacturers, but it hasn't stopped us, different manufacturers have different ideas , we've been working with certain service providers and contracts are still in he offing but what we what to do is get that part of the regs in, with everything, I wouldn't say watertight but everything's on the table" OEM manager three*

> *"the SMMT that looks after the interests of the motor industry, the ABI the other people, they've got their own committees, but we will get together at certain meetings. We are trying to do what's best for the government and the industry but we don't want to be pulled over a barrel, we don't want to be made responsible for something that we you know we feel should be somebody else's responsibility" OEM manager two*

There was a great risk that the costs of complying to the Directive would be extremely high, with statements of £500 million in liabilities, which caused delays in negotiating a solution. Uncertainty was also introduced by the Government through delays although direct communication with the various stakeholders involved was common.

> *"Its been long because everybody wants something for nothing, you are talking about if you look at the volumes involved, especially with GM and Ford, and possibly Rover and VW to name a few, the number of old vehicles" OEM manager one*

In the end legislation was passed that meant collection systems would only start in 2007, and hence the UK would not meet the deadlines set by the European Union and hence companies in the UK would have less time to meet the overall objectives of reducing landfill waste and increasing the amount of recycling of end of life vehicles.

> *"they've postponed the meeting about five times at the minute. [DTI rep] who looks after the DTI in Westminster, he's coming up to give us an overview on what*

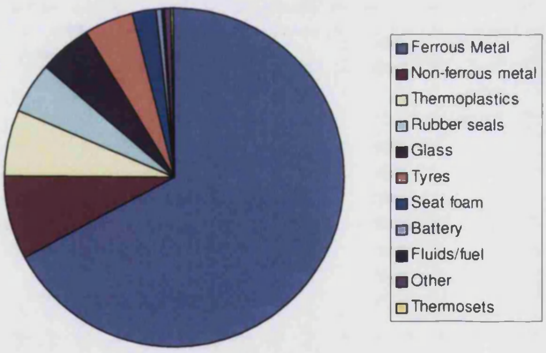
the second consultation paper means... with 126 pages and my boss has said condense it into two pages" OEM manager two

"there's 5 or 6 areas that need to be ironed out that we need to do a bit of lobbying on, with the government" OEM manager three

"We are keeping the pressure on from a very high level, sending a letter to Patricia Hewitt and getting a letter back and it's still not happening. But we hope someone doesn't throw in a curve ball and we can progress." OEM manager four

The delays in the transposition of the directive meant that contracts were not negotiated until very close to the implementation dates, due to the risk that terms would not reflect the regulated standards. This indicates a process driven by the requirement to meet the regulation at the lowest cost and this is reflected in the findings of the analysis of this case. Ultimately, two organisations were set up through the dismantlers and the shredders (Autogreen and Cartakeback) to provide a recovery service to OEMs at the lowest cost. GME chose Autogreen as its first contractor for product recovery.

Product characteristics



Total ELVs per year	**2.5 Million**
Total GM ELVs per year	**300,000**
Number of product components	**2000 - 4000**

Average ELV Material Composition

Figure 6-14 Product characteristics of ELVs (Source: Autogreen, Automotive news)

6.7.3 Drivers

The over-riding view of the OEM when discussing the drivers for vehicle take-back and recycling, is the legal dimension. The End of Life Vehicle Directive specifically mandates that OEMs share in the responsibility for the 'free' take back of vehicles and the appropriate treatment of these vehicles at the end of their life.

"legislation is a huge driver especially on ELV" OEM manager three

"the number one objective is to be legal" OEM manager two

The following table derives second order categories for the drivers of setting up relationships for product recovery based on first order categories from coded data (example shown in Appendix Four).

Table 6-17 Case Three - Drivers

1st order categories	2nd order categories (linked to established concepts for drivers)
• Stronger links with he customer base	Competitiveness – extend customer relationship
• Revenue from used parts	Competitiveness – reduce cost impact of legislation
• Free service to OEMs	Competitiveness – reduce cost impact of legislation
• Not competitive issue for OEMs, agree to tackle at industry level	Legitimacy – industry level compliance
• The same target for all manufacturers	Legitimacy – industry level compliance
• Not promoted through distribution / advertising of product	Competitiveness – NOT competitive
• Meet regulation	Legitimacy – meet legislation
• Fulfil policy statements	Legitimacy – internal policy commitment
• Focus on the legal side	Legitimacy – meet legislation
• Uncertain regulatory outcomes	Competitiveness – reduce risk of legislation impacts
• High level engagement by OEMs	Competitiveness – high level perception of risk of legislation impacts
• increase credibility and image of dismantlers	Legitimacy – improve image of dismantler
• not a consumer priority	Competitiveness – NOT competitive
• aspiration to exceed legal requirements	Legitimacy – internal policy commitment

Hence the approach has been to put in systems and processes that meet the requirements set down in European law and being transposed into UK law by the DTI and DEFRA.

To an extent OEMs speak about corporate responsibility issues with specific reference to company environmental policy, reputation and image. However the role here is not clear. On the other hand, implementing end of life product recovery is not seen as a competitive issue for car manufacturers.

"I don't think anybody's got much of a competitive strategy, unlike BMW in the old days and I'm surprised in a way that no -one's taken a competitive strategy" GME Product Take-Back Manager

"So policy statement and law are basically the drivers." OEM manager 2

"Its interesting that materials recycling isn't seen as a competitive area", GME Environmental Manager"

"within the UK car manufacturers we've treated end of life vehicle and issues of how recyclable is your car as a non-competitive issue and as such we have almost

declined by agreement to use any publicity which declares our car is more recyclable or is more environmentally friendly than A . Another car," OEM manager two

This is due to a number of reasons. First, end of life vehicle owners tend not to be the OEMs core customers "*we are a long way from the last owners*" and therefore have less reason to influence this part of the market. Second, vehicle recycling appears to be low on the list of priorities when actually buying a car, compared with fuel consumption for example "*the car is a very complex beast when it comes to environmental issues, and actually recycling is arguably not top of the significant list, ".* Third, to bring about the right economies of scale for the returns network, OEMs need to share the infrastructure and informally agree not to compete (even though some cars may be more recyclable than others by design).

6.7.4 Operations

In terms of product recovery the OEMs have traditionally not been involved in the actual return and recycling of vehicles themselves. The area of activity is in the design or vehicle for recycling.

"we've had dismantling manuals we've had marked plastics for years and years, but what we're saying now as legislation caught up with us". OEM manager three

However some OEMs especially premium marques have been involved in remanufacturing of some parts such as the engine and gearbox where there is a significant aftermarket for cheaper, used replacement parts. OEMs also owned some research facilities to test the economics of certain design decisions on dismantling.

"we at [OEM] had our own recycling centre but it was a research centre and we had it for about half a dozen years, ……, so we're not dismantlers, we're not shredders, we haven't got the facilities" OEM manager three

The product recovery operations under the regulated regime are to be organised through the established network, in this case Autogreen, which owns a depollution and dismantling facility. Currently there are a further 50 outlets in the ATF network contracted to Autogreen. Autogreen also operates a training function for other ATFs to meet regulated standards.

Bridges also operate depollution, collection, dismantling processes alongside the second hand parts warehouse and selling system used to provide revenue from the car stock.

The recovery process is common to all dismantlers following the steps of car depollution and assessment (including removal of battery and wheels), storage, dismantling, crushing and transportation to a shredding site where cars are shredded and the resulting materials separated.

6.7.5 Relationship characteristics

The following table outlines the main relationship characteristics encountered from the primary data collected during interview and site visits with the case study companies and also secondary interview sources.

Table 6-18 Case Three - Relationship characteristics

Characteristics	GM and Autogreen	GM and Bridges
General	Prime contractor for vehicle take back for GM in UK	Contractor part of wider geographic network, fewer links to GM than Autogreen
Duration	Long term contract (10 years) based on legislative requirement	Long term contract (10 years) based on legislative requirement
Asset specificity	No brand specific assets (OEM has dedicated personnel to ELV but not specific to contractor) Information system to track GM vehicle recycling rate (common to all OEMs).	No brand specific assets (OEM has dedicated personnel to ELV but not specific to contractor)
Dependence	Dependent on one contractor to coordinate and control the network performance (could change contracts with individual network sites). One other recovery coordinator in the UK	Based on geographical location, so could switch if similar site close by, but limited by geographical location.
Certainty	Trust viewed as important Risks to reputation of OEM from Dismantler behaviour Uncertain development of legislation – affects the way relationship set up	Long term relationship Risks to reputation of OEM from Dismantler behaviour
Knowledge sharing	Knowledge sharing in the network part of the arrangement (e.g. IDIS system) Intense information sharing during joint lobbying and system design Transfer from dismantlers to OEM, on process issues/costs Small link to design – through design studies	Knowledge sharing in the network part of the arrangement (e.g. IDIS system) Small link to design – through studies
Reason for sourcing	Image and capability to support the legal requirements through experience	Location, Image and credibility
Attitude to price changes	Will renegotiate if costs change (up or down) Based on cost changes at dismantler	Opportunity to renegotiation, free collection
R&D	R&D shared between OEM through CARE Some dismantling studies to assess costs	Limited dismantling studies
Modes of governance	Long term contract, mutual support	Long term contract

	through marketing and branding	
Complementary resources	Dismantlers database of customers Expertise in profitable/low cost dismantling Marketing of used parts Marketing and branding of the OEM Advertising know-how	Dismantling and depollution facilities
Risk sharing	OEM liable by contractor offers for free, based on parts revenues	OEM liable but contractor offers for free, based on parts revenues

Probably the most significant factor in setting up a recycling network in the UK to deal with one OEMs vehicles, a volume manufacturer such as Vauxhall, is the development of economies of scale and yet allowing a distributed network of collectors/recyclers. Therefore, the OEMs in the UK have worked closely together to define a network of recyclers to whom they can issue contracts to recycle their vehicles.

> *"it is incredibly difficult to make this work financially, by working on your own, there are some people who are attracted by it because some people believe they have higher value ELVs but the mathematics are different but for an average ELV for most people and [OEM) is a good example you just can't make it work, so you have to look straightway at who you can work with and that's why we work with what may be perceived as competitors, or competitor brands rather than competitors." OEM manager three*

As this is not a core part of the business for vehicle manufacturers there is a need to acquire the ability to recover vehicles through a contract with a service provider e.g. a dismantler.

> *"We wouldn't have such as similar relationship I don't think as we would with a mainstream supplier it would be contractual arrangement as it is with a supplier in any case, but our expertise actually is not in that area" OEM manager two*

The long term nature of the contracts is due to the 2015 target date for 95% recovery by vehicle weight, in order to provide certainty to all the stakeholders (OEMs that the dismantlers are committed, government that the OEMs have put a network in place for last users).

At present there are no specific investments dedicated to an OEM or contractor despite the fact that standards may be different across OEMs as supported below

> *"it can lead to some tension, on the whole it works very well, and you've got to spread resources but I'll give you an example of a we are currently building a network, the standards that we might want to impose on the network, very often*

they are going to be the same as [other OEM], but sometimes may be a bit higher, and if you are going for a common network, which we are to make the whole thing work, that can sometimes, if not handled carefully, could lead to an issue." OEM manager three

The network of ATFs is common to all OEMs despite the fact that different OEM vehicles may be different with respect to recyclability. Neither contractors (Autogreen not Bridges) differentiate between different brand vehicles.

The issue of uncertainty was mainly faced during the transposition of the EU directive, which has largely been finalised. The collaborative arrangements (Knowledge sharing, site audits on behalf of the OEM) protect against contractors not fulfilling the terms of the contract (to depollute the vehicle and handle within the legal constraints, as well as provide a free service to the OEMs based on revenues).

"there's huge uncertainty and risk about the different elements of the legislation, and how they might go like what will the government do about orphaned vehicles, what will the government do about sort of how close have these points got to be for the end user, I mean they could still come up with crazy suggestions like its got to be within one mile of their drop off point," OEM manager two

Overall the network of dismantlers is set up so that the OEM is dependent on one main contractor who coordinates the recycling of their products across the UK. Despite this dependence there is also an element of risk sharing in that the OEM, theoretically pays for a percentage of the take back costs if the overall values of end of life vehicles are negative (when balanced against revenues from the sales of spare parts and materials). Furthermore the relationships are contractually defined for a 10 year period in order to provide stability in the contract and a view to achieving the overall objective of increasing the levels of recycling in 2015 to 95% (including energy recovery).

Both relationships show evidence of high levels of information sharing. This is due to the mandated requirement for each brand to provide records of recycling rates for their vehicles.

"legally and morally I suppose we want to share that with everybody like IDIS, IDIS isn't just open to a certain group of people its open to anybody that's a legal dismantler and the same will be true for all this information, we're not keeping back from people who aren't in the network, because legally and morally we shouldn't but I think its fair to say that people in our network we will probably

give more information if its actually needed rather than perhaps the bare minimum." OEM manager three

In addition, the premise that the contracts were based on a cost neutral system for the OEMs – the parts revenues would balance the compliance costs such as depollution – means that GME has to be confident that revenues at least provide a free take back situation. As a result the contracts include an element of open book accounting, first to verify recycling targets are being met, and second, the costs will not be passed on to the GME. As part of the arrangement with all the network members (ATFs), Autogreen will record on behalf of the network and report the levels of recycling back to the OEMs. Dismantlers have been operating open book systems with local authorities for many years, to justify the cost of abandoned vehicle collection, hence this system is maintained for the new regulatory regime.

OEMs have run many trial projects with dismantlers in the past, providing input into the R&D cycle, as highlighted in the following quotes:

"he has highlighted from the dismantling exercise that we have already done, if you change this, or if instead of using a glue you actually use a fastener, and actually you can unzip that, take that off and hey that's recyclable, but actually as you've glued it on, actually I'm not going to spend half an hour trying to cut it off so basically at this point in time that's going into shredder residue basically and towards landfill. So working with dismantlers and getting their practical feedback in terms in time that where their big cost is, their big overhead is time, so anything we can do to have parts which are re-useable and recyclable." OEM manager two

Knowledge sharing – OEMs share design information and studies

"we've just completed a practical exercise on how recyclable is a [brand car] and so we've take a brand new car which was destined for scrap because of an issue on the build process so it couldn't be sold we don't build very many of those I must stress, and from a practical viewpoint we achieved a 97.7% recyclability, reuse/recyclability, so just less than 3% would be going to landfill, so we have some confidence that from a practical viewpoint a dismantler can get a good result from a [brand car]." OEM manager two

With regard to complementary assets, the key point is that GME has no assets that specifically enable end of life product recovery, apart from influence over the design of the product (which is clearly key to the overall economics). The logistics of the recovery process is only handled by the dismantlers with their skills and equipments and sites that they have built up over time. Autogreen in particular benefits from GME's marketing expertise in order to build up credibility with other potential customers.

6.7.6 Capabilities: pre-existing, acquired and developed

The following table details the capabilities derived from the data collection phase. Probably the most notable feature of this case is that there were far fewer examples of capability for end of life product recovery. This can be explained partly as a function of the recent establishment of the product recovery process as well as the clear lack of involvement in the 'process chain' that the OEM takes.

Table 6-19 Case Three - Capabilities

First order description	**Second order description**		
	GM	**Autogreen**	**Bridges**
• Ability to lobby and shape forthcoming legislation	**Developed:** Influence future legislation	**Developed:** Influence future legislation	-
• Ability to design cars and work with suppliers	**Pre-exist**: Influence design for product recovery	-	-
• Dismantling business built up over time	-	**Pre-exist**: Build up processes over time	**Pre-exist**: Build up processes over time
• Ability to leverage marketing resources	**Pre-exist**: Marketing	**Acquired:** Marketing	
• Network linkages for recovery	**Acquired:** Network linkages for recovery	**Pre-exist**: Network linkages for recovery	-
• Make profitable use of used parts - re-use • Sell knowledge developed (training) • Make profitable use of used parts - reman	-	**Pre-exist & Developed**: Provide revenue to reduce compliance costs Provide revenue to reduce compliance costs	**Pre-exist**: Provide revenue to reduce compliance costs
• Ability to recapture customers	**Developed:** Re-establish customer link	-	-
• Ability to build credibility/legitimacy	-	**Acquired:** Build legitimacy	**Acquired:** Build legitimacy

Network linkages relate to the ability to set up network links facilitated through Autogreen who check quality and location of network sites. This is seen as a capability because Autogreen has developed a set of relationships with dismantlers across the UK over time (partly by recruiting personnel from the dismantlers trade association).

Revenue to meet compliance costs is a pre-existing capability held at dismantlers to provide a balance between the cost of recovering products at a certain recycling level, while at the same time providing a margin for the dismantler.

Influencing future legislation is the ability to work together with dismantlers and governments to co-develop a regulatory regime this fits the interests of all the parties involved. It is the OEMs that hold most of the resource in this respect (departments dedicated to regulatory compliance), although the dismantlers can act under the umbrella of a trade organisation. The OEM also has significant resource to influence the design of the car to reduce the costs of depollution and dismantling and GME will actively feedback knowledge about the recovery process to the design team[31].

> *"we will have to enter into some negotiation with the dismantlers to at try to agree a unit price for a [brand car] at the end of the day, and it may be different for a [brand A] it may be different for a [brand B], I don't know, but certainly we will be looking at trying to minimise the cost impact the we will have to, if our car happens to be better then the only commercial advantage is that we will not have to pay so much or whatever system is being used to accrue the costs to cover take back, hopefully we can minimise that." OEM manager two*

Marketing abilities at GME will allow the dismantler Autogreen to raise its profile by leveraging marketing contacts to reduce the cost of presenting an image to last users.

A further capability relates to the developing the links with 'lost' customers. Re-establishing the customer link is a way for GME to develop markets for re-useable parts and provide increased revenues (assuming this does not cannibalise the, already existing and profitable, brand aftermarket products).

The ability to build legitimacy will be a success factor for the dismantlers, which Autogreen believes GME has been able to improve. Autogreen sees it can attract more customers (OEMs) than its competitors, by obtaining assistance on the image and 'being associated with' GME.

6.7.7 Benefits

The following table outlines the main benefits of the operations related to the relationships studied.

[31] The feedback only becomes valuable if the dismantlers cost for that brand reduce and that saving is passed on to the OEMs (e.g. time to depollute or time to remove bumpers is less)

Table 6-20 Case Three - Benefits

Type of benefit	First order description	Second order description
Eco ben	• Reduce waste to landfill	**Reduces waste**
	• Incorporate design changes that facilitate recycling	**Improve design for recycling**
Org ben	• Incorporate sensible design changes to vehicle that reflect dismantling reality	**Improve the design of the product for lower cost dismantling**
	• Offset compliance costs with parts revenues and other services	**Low cost compliance**
	• Re-establish links with customers	**Customer relationship**
	• Use OEM branding to improve image	**Legitimacy for dismantlers**

The main benefit of the relationships and capabilities utilised as a result of the relationships is linked to compliance to the ELV Directive at an acceptable cost (in the case of OEMs, no cost). The relationships lead to the establishment of a collection network, that last users can take their end of life cars to at no cost (apart from actual delivery). The OEM benefits from complying with the regulation and avoiding non-compliance costs. The benefit to the environment relates to the planned reduction in landfill waste, in tandem with design changes to vehicles that should reduce the impact on any waste reaching landfill (such as hazardous materials).

The contracts between the OEMs and dismantlers stipulate that dismantlers offer a free take back service to last users at no cost to the OEMs, avoiding the necessity for accruals on the companies balance sheet that could negatively affect share valuations (being a liability). Questions still remain over whether the ELV directive will actually reduce landfill waste and/or reduce its toxicity, but this is not the focus of this study.

6.7.8 Synthesis and Conclusions

The following figure summarises the relationships between the concepts studied in the automobile case.

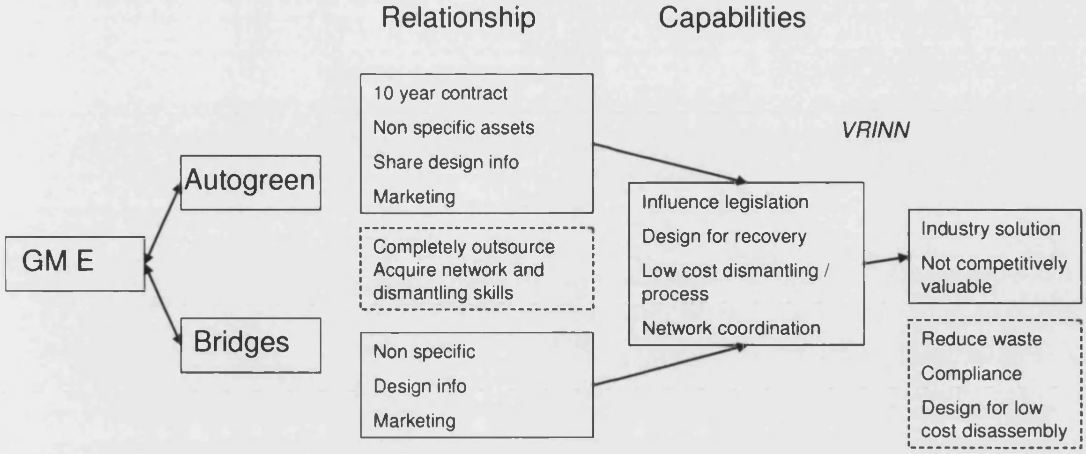


Figure 6-15 Links between case three concepts

One of the main features of this case is the lack of competitiveness drivers to set up relationships for product recovery. The response to the ELV directive has been at an industry level with the benefits of the system design being shared across the industry, i.e. compliance. There is some evidence that capabilities at the OEM could improve the performance of the dismantlers by improving image and legitimacy generally. However, the capabilities of the dismantlers are only focussed on providing a service to OEMs in general and not GME specifically. Therefore any advantage gained through sharing knowledge and information from GME is shared across all OEMs. If, by design, the GME vehicles that are recovered are easier to recycle, the reduction in recovery costs could be passed on to GME, however, the contracts are based on 'no cost' and revenues are not expected. Any advantage then is only retained by the dismantlers. However as the recycling targets increase this advantage will diminish as the cost to reach recycling levels increase generally.

6.8 Conclusions

Contextually these cases demonstrate that the firms are mainly driven by legislative developments in industries that have clubbed together to influence the development of legislation, to ensure the cost impact is minimised. In the case of Xerox however, an individual approach that has been integrated into the product service offering defines some distinct differences. The specific drivers have been shown and tend to relate to meeting legislation (avoiding reputation loss and costs of non-compliance) as well as possibilities to improve revenues. The cases also show a range of operations, that are distributed across the partners of the relationships based on the identified resources of the firms (physical assets such as depollution facilities and know-how of materials markets). All the relationships are collaborative to varying degrees in accordance with the main characteristics used in this study.

With regard to capabilities there are few examples of developed capabilities from the relationships. It was more common to find OEMs accessing the capabilities of other firms. Furthermore many capabilities show the attributes of competitive value but at the same time the strategy is of low cost compliance to current or expected legislation. This means that benefits relate to lowest cost solutions as the main outcome. In addition ecological benefits are sometimes doubtful which could adversely affect reputation. Outsourcing responsibility leads to possible risks to reputation if products are not dealt with in the most appropriate way, and hence, collaboration appears to be one way to control for this risk. A link to design clearly gives advantages (as in the Xerox case), through lower cost dismantling and recycling, however this is not present in all the cases.

The next chapter analyses the cases in a comparative fashion in order to highlight the similarities and differences, and provide an explanation for these attributes.

SECTION THREE

Chapter 7 Cross case analysis

7.1 Introduction

The purpose of this chapter is to provide a detailed analysis of the main concepts that are included in the study in a manner that integrates the findings from each of the cases. The chapter starts with an analysis of the context and driver for each of the cases showing differences due to industry type, competitive environment and the legislative background to product recovery for each case. The chapter then goes on to show which operations are included in the cases and how these differ in terms of scope of each of the case study companies. The next section then compares the characteristics of each of the relationships in the cases with specific reference to the forms described in the literature and key aspects of collaborative relationships. The chapter then proceeds by comparing the access and development of capabilities across the dyadic relationships in each case and across the cases to show the main commonalities and differences. Capabilities are then linked to the respective outcomes in terms of benefits, in order to show how relationships in these cases lead to capabilities for product recovery and hence benefits to the firm.

7.2 Context and Drivers

The cross case analysis of context and drivers centres round the discussion of table 7-1, which summarises the findings of each case.

Table 7-1 Contextual factors and drivers for product recovery

	Tyres	Photocopiers	Automobiles
Contextual factors			
	Follow model developed in other countries Links to the last users, but high price competitiveness – low loyalty	Direct link to last user through lease programs Established system since 1980	No direct links to last user Industry level response to regulation
Drivers			
Legitimacy	indirect legislative pressure avoid antitrust	Meet legislation reduce impact of legislation pre-empt new legislation	industry level compliance meet legislation internal policy commitment improve image of dismantler
Competitiveness	lower costs lower consumer costs	customer expectation reduce impact of legislation	extend customer relationship reduce cost impact of legislation NOT competitive high level perception of risk of legislation impacts
Ecological/Ethical	-	-	-

7.2.1 Context

Each of the cases demonstrate specific contextual factors that influence the product recovery strategies adopted. These factors relate to the OEMs policies, legislative pressure (actual and perceived, and the companies' or industry's response), experience of product recovery (including in other countries), the product business model (OEM links to the last user).

The tyre industry has been led by Michelin to take up product recovery of end of life tyres (ELTs). Michelin's experience in France has been to introduce a joint venture (with equity stakes held by all the major tyre OEMs), this has been in tandem with a Decree introduced by the French government to require a take back scheme for tyres that provides a fee-based responsible disposal of ELTs, alongside the total ban on landfilling tyres (in response to the EU level Landfill Directive prohibiting tyre disposal in landfill). Other countries such as Germany and Sweden have also required a ban on landfilling tyres and a take back scheme. Although Michelin (and other tyre OEMs) have a link to last users i.e. when tyres are replaced the OEM has an opportunity for a sale, the industry is highly price competitive with typically low customer loyalty. In the UK there is no direct requirement for Michelin to take back tyres, however a take back fee (normally £1 per tyre) has been introduced. Retailers take this fee to pay for collection of ELTs, but will normally chose a collector with the lowest fee (tyre retailers are under high cost pressure and there is no requirement for them to contract with any specific collector except that the ultimate disposal route has to be legal).

The Xerox case shows a long established system for taking back photocopiers and accessories (toner cartridges etc). Xerox have a close relationship with last users of their equipment through the leasing/service business model (so that Xerox either leases machines, retaining ownership, or simply provides a copying service). This means that Xerox, in affect, makes decisions about when to 'retire' products when their useful life is ended. Through the imposition of the WEEE Directive, which has yet to be transposed into law in the UK, Xerox will be required to take back it's end of life products and ensure that 75% of these products (by weight) are recycled. Xerox has been taking back products since 1980, across the world and has developed a market of used machines ('second user programme') and even provided remanufactured machines of an 'as new' condition. In order to meet proactive internal environmental policies and in response to the European Union proposals to recycle WEEE, Xerox Europe implemented recycling schemes at all its sites. The Asset recovery centre in the UK is the main site of photocopier returns where remanufacturing and recycling of copier returns occurs. Xerox set a target to exceed the WEEE Directive of 75% recycling (including re-use) of end of life products by introducing new recycling operations. While there has been an industry level lobbying response to the WEEE Directive, with Xerox Europe present on the committees of ICER and Intellect (both electronic equipment industry groups), there has not been an industry level take back proposal for business to business products.

The threat of legislation, and actual implementation in the UK has also been a major contextual factor the automobile case. The European end of life vehicle directive requires that vehicle manufacturers provide a free take back service to last users, that allows the recovery (and recycling) of vehicles to level of 85% (by weight) by 2006 and 95% by 2015. Vehicle manufacturers across Europe worked together through various industry associations such as ACEA and the SMMT in the UK. Vehicle manufacturers typically have few links with last users of vehicles (with the average end of life vehicle being 12.6 years old, the vehicle being owned by many individuals over that time) and are not able to directly influence take back. The only exception is insurance write-off, for which insurers have responsibility. Hence as a protective measure, vehicle manufacturers have worked together on research projects (to examine the dismantling and recycling process and design of recyclable cars) and lobbied government to reduce the financial burden of the new ELV Directive. Product recycling is not viewed as a competitive area and thus OEMs have cooperated at many levels.

7.2.2 Drivers

The factors that relate to drivers for adopting product recovery and the ensuing relationships fall into two categories: legitimacy and competitiveness. While the literature suggested that ethical motivations could also trigger ecological responses (see Chapter 3 Environmental responsibility p.80), in the three cases of dyads examined in this research there was no supporting evidence to show this is a factor.

The first driver that is present in all the cases studied relates to legitimacy. The over-riding factor that leads to legitimacy being of significance is the need of OEMs to meet or pre-empt regulatory requirements such as new waste laws banning certain waste from landfill, recycling vehicles and recycling electrical and electronic waste. In one instance, the tyre industry, there is no direct legislation, but the future threat of possible producer responsibility is enough for Michelin to act and put in place compliance schemes. In addition to the legitimacy afforded by compliance to legislation, all the large companies involved in the study had environmental policies which stated how the company deals with end of life products, meaning that the activity can be partially traced back to internal commitments to reduce their ecological impact (reduce landfill waste). These policies themselves are again influenced by the need to comply with legislation. In the automobile case, that relationships were specifically mandated through the regulatory requirement to establish a take-back network that conformed to certain geographic constraints.

A marked difference in the companies' drivers for product recovery is in the domain of competitiveness. While this is also present in all the cases, the cases were split between competitiveness through lower cost (lower material costs, lower costs to meet regulation) or through increased revenues (extending the customer service remit to cover ecologically responsible recovery of their used products). It is not a clear split between these two aspects of competitiveness however. The case of tyres is driven by the need to comply with possible new regulation at a low cost. The development of the JV was also of competitive benefit to the other JV partner Lafarge, due to the supply instability from the used tyre industry whereby one of the objectives of the JV was to reduce this effect. From the point of view of photocopiers, it is evident that the current processes that extend the customer service remit are in place to increase revenue, but at least one of the relationships was put in place to reduce the cost impact of a new regulatory regime (WEEE) on the existing process of product recovery. In the automobile case the main driver for the relationships that had been set up was the reduction of compliance cost (reducing the risk that large accruals on the balance sheet would ultimately affect market share). Thus the costs would be reduced effectively by subsidising the recovery and depollution process through parts sales revenues by dismantlers.

To summarise, the drivers for setting up relationships for product recovery are linked to both legitimacy and competitiveness motivations. In all the cases, the imposition, or threat of new legislation means that action has to be taken to comply (or safeguard future compliance). The contracts support the OEM to reduce the impact on the balance sheet through the focus on reducing the cost implications of compliance. Only in the case of Xerox, was there any link to possible increases in revenue from product recovery as an extended part of the product-service package, alongside the drive to minimise compliance costs (to reach high recycling levels). Figure 7 - 1 shows a 2x2 matrix placing the cases according to why product recovery had been implemented by the OEMs.

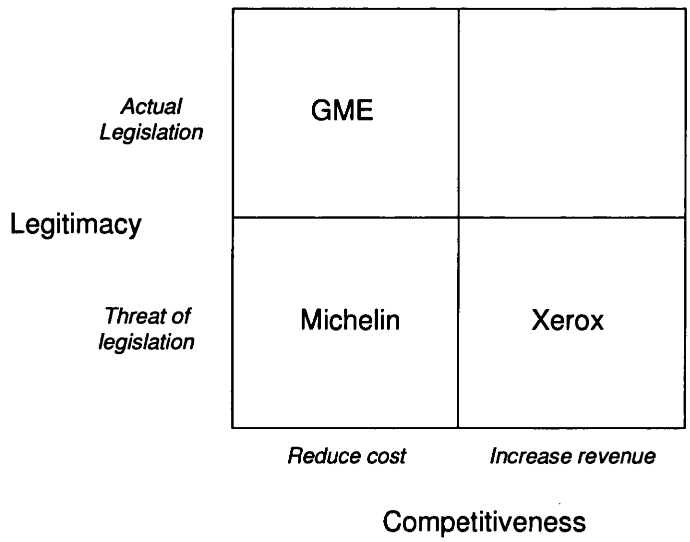


Figure 7-1 Matrix of drivers for product recovery for the three cases

The intention of Figure 7-1 is not to distinguish between reactive (driven by legislation only) and proactive firms (pre-empting legislation and seeking opportunities from product stewardship). The discussion of drivers provides a contextual picture for what has motivated the firms to adopt product stewardship from the perspectives of legitimacy and competitiveness. As the discussion suggests, each of the cases show a mix of drivers, linked to both legitimacy and competitiveness to differing degrees.

7.3 Operations

The following table outlines the distribution of product recovery activities across the companies in each of the cases. The table aids understanding of the spread of product recovery operations across the value chain and indicates which firm has responsibility for which link in the recovery chain.

Table 7-2 Summary of the product recovery operations

	Collection transport	Sorting assessment	Depollution dismantling	Repair reuse refurb reman	Recycle
Michelin	-	-	-	-	-
Lafarge	-	-	-	-	X
Sapphire	-	-	X	-	-
GME	-	-	-	-	-
Autogreen	X	X	X	X	-
Bridges	X	X	X	X	-
Xerox	-	X	X	X	-
Covertronic	-	-	X	-	X
Flextronics	-	X	X	X	-

One of the main points from table 7-2 is that with the exception of Xerox, the OEMs do not carry out product take back operations themselves. Xerox had established their own remanufacturing site and only outsourced peripheral operations such as transport and actual recycling (except in the case of the Xerox-Flextronics relationship where all the operations were outsourced apart from some supply chain coordination activity). In making OEMs responsible for product recovery through legislation (or threat of legislation), GME and Michelin have sought to discharge their responsibilities through contracting with specialists in the product recovery field.

7.3.1 *Collection and transport*

As Table 7-2 indicates only one of the cases included any product collection or transportation services. The collection of end of life products from end users is often contracted to a transportation specialist - such as TNT in the Copier case (which in fact did demonstrate some collaborative characteristics: long term, shared site, demand information sharing). The tyre product recovery operations relied on existing service providers (tyre collectors such as WTS and smaller local collectors) to bring tyres to the Sapphire processing plants and other haulage firms to transport tyre chips to the cement kilns. In the case of end of life cars, last owners most often bring vehicles to the ATFs (insurance companies relying on small car transporter companies or breakdown service providers). Autogreen and Bridges also own their own transporters to collect end of life vehicles for example for dumped cars or cars that last owners cannot drive due to breakdown (for which last owners pay a fee).

7.3.2 *Sorting and assessment*

In the case of the tyre industry it is interesting to note that sorting and assessment takes place before the tyres arrive at Sapphire (the first processing point). The nature of the product (an integral and homogenous unit) means that it is assessed as either suitable for re-mold or for disposal / recycling, through a simple visual check. This operation is carried out by the tyre collector. The other two products are considerably more complex to assess and have a number of options available once assessed: refurbish and re-sale, cannibalisation for spares and recycling. Due to the potential revenue generation, Xerox employs a number of assessment stages: first with TNT to judge if the machine is beyond refurbishment potential and second with Xerox using sophisticated signature analysis[32] to judge the level of refurbishment or cannibalisation necessary. In the case of ELVs, the dismantlers assess the product as soon as it arrives to evaluate potential parts re-sale value, which in turn determines if the vehicle will be stored or immediately crushed. The dismantler's knowledge of valuable sources of parts is used to plan how best to recover the product (parts re-use or purely material recycling).

7.3.3 *Depollution and dismantling*

In this study, depollution is an activity that is limited to the end of life treatment of vehicles. Cars contain hazardous materials such as oil, acid (in batteries) and heavy

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[32] A process that utilizes electronic testing equipment to judge the future life of the product.

metals and treatment facilities are mandated to remove all such substances before dismantling vehicles. Dismantling is only common to the copier and automobile cases of this study. The level of dismantling is dependent on the economics of whether the cost of removing parts and materials is outweighed by the revenue from re-selling the parts or materials. In the case of Xerox it is the results of the assessment that determines how far to dismantle the copiers themselves, an operation that is mirrored by Flextronics at the outsourced manufacturing site in Venray. If parts cannot be re-used in refurbished machines, the machine is passed onto the recycling provider, in this case Covertronic who then dismantles the machine for the recycling markets (as described in chapter six). As a homogenous product, tyres do not require dismantling in the traditional sense (breaking down to constituent components). Instead, tyres are chipped by Sapphire for more efficient transport and consumption in the Lafarge cement kilns.

7.3.4 Reuse, Repair, refurbishment and remanufacturing

The only example of repair, refurbishment or remanufacturing in the study is that of copier machines (Xerox) and their related consumables (Flextronics). End of life vehicles may contain parts that can be remanufactured (such as engines or gearboxes), thus dismantlers will send such items to a specialist where a market exists, but this was out of the scope of this study. Tyres can be re-moulded (a type of refurbishment) and sold as re-moulds, but again this was out of scope of the study.

7.3.5 Recycling

Recycling operations exist at Lafarge, where the materials contained within a tyre are used to provide energy and form part of the final cement product. Covertronic also perform recycling activities for Xerox, in the granulation of ABS plastic that is then used again as a raw material for copier machine cladding. Recycling occurs in all the products' value chains, but in the case of automobiles are part of operations further down the value chain (normally after the shredding of the vehicle).

The operations that form the backdrop to this study are spread across the product recovery value chain accounting for the different specialisms required for product recovery. The decision to contract or outsource certain operations is analysed next in the section on collaborative relationships.

7.4 The collaborative relationships

The cross-case analysis of the relationships for product recovery is based on table 8-3 which summarises the main relationship characteristics.

7.4.1 The role of motivations, duration, governance modes, resource complementarity

As shown in table 7–3, examining the motivations for setting up relationships across the cases showed that two main factors were considered. The first significant reason for choosing a particular company was the ability of a contractor to provide sufficient capacity to deal with end of life returns for their set of operations. This would be in terms of both storage and process capacity. Second, the image of the contractor and proven ability to meet regulatory requirements was a significant factor especially for those firms driven to adopt product recovery for legitimacy reasons, such as GME and Michelin.

Each of the relationships was included in the study due to their collaborative nature, hence longevity was a feature of this case selection. Despite this there were differences in the expected duration of the relationships. A particular point to notice is that in the automotive sector, relationships were set up with contractors over a 10 year period in order to provide certainty that the legislative requirements could be met in future (where recycling target dates reach to 2015).

Table 7-3 The role of motivations, duration, governance modes, resource complementarity

	Michelin Lafarge	Michelin Sapphire	Xerox Covertronic	Xerox Flextronic	GME Autogreen	GME Bridges
General	The attitude of Michelin is to develop a JV in each country with shares held by all the tyre manufacturers represented in that country	Intermediate collects all Michelin franchise's tyres for Sapphire equivalent to all Michelin ELTS in UK No contracts with other collectors	Viewed as a partnership arrangement with transparency in information sharing Aims to meet future WEEE legislation	Part of the global strategy to outsource manufacturing capacity	Prime contractor for vehicle take back for GM in UK Mandated take back	Contractor part of wider geographic network, fewer links to GM than Autogreen Mandated take back
Duration	JV, open ended, running for 3 years so far	Joint venture, open ended agreement.	1 year rolling contract, lasting 2 years so far	Contract with Flextronics for 5 years (likely to continue)	Long term contract (10 years) based on legislative requirement	Long term contract (10 years) based on legislative requirement
Modes of governance	Joint venture arrangement	Joint venture arrangement	Contractually based, but with weekly site meetings and shared information systems	Long term contract, based on open book arrangements	Long term contract, mutual support through marketing and branding	Long term contract
Reason for sourcing decision	Complementary skills, viable disposal route already established, capacity for all Michelin tyres	Sufficient capacity to deal with all Michelin tyres Expertise	Experience of WEEE Could offer a turnkey solution	Global player in contract manufacturing	Image and capability to support the legal requirements	location and Image and credibility
Complementary resources	Marketing and distribution power of Michelin Disposal route provided by Lafarge	Michelin – power over franchise retailers and marketing Sapphire - developed resources in JV,	Xerox holds detailed knowledge about the machines and how to dismantle them, Covertronic are able to efficiently trade materials and parts	Experience in contract manufacturing little experience in remanufacturing but wish to acquire this capability	Dismantlers database of customers Expertise in profitable/low cost dismantling Marketing parts Marketing and branding	Expertise in profitable/low cost dismantling Marketing parts

The governance modes varied across each case, and again was a reason for choosing each case. The tyre industry joint venture was designed in keeping with structures that Michelin had already started to set up across the world (e.g. Aliapur in France, although this venture involved more than one tyre OEM). The equity split reflected the relative input each partner was prepared to make to the product recovery process, whereby the investment into assets by Michelin was minimal and resources were more intangible: pressure on the retail base, legitimacy effects.

The other two cases relied on contractual agreements over long periods, to provide a set of services to the contracting firm, including collection of end of life product, sorting, dismantling, depollution and recycling of dismantled parts and materials. Open book systems are in place in each relationship to ensure that either a free service is provided or revenues are maximised.

The issue of resource complementarity focuses on which resources each partner brings to a relationship that potentially provide benefits when coupled together. Both the Xerox and Michelin cases show examples of complementarity of assets between the contracting partners for example coupling Michelin's influence over the distribution channel and Lafarge's process for recovering all Michelin's end of life tyres. It was less clear where complementarity existed in the automobile relationships. The vehicle OEM design capabilities meant that cars could be developed to be more recyclable, but the link between dismantlers and designers had not been explicitly established.

7.4.2 *The role of data, knowledge, R&D and attitudes to operational factors*

Table 7-4 The role of data, knowledge, R&D and attitudes to operational factors

	Michelin Lafarge	Michelin Sapphire	Xerox Covertronic	Xerox Flextronic	GME Autogreen	GME Bridges
Asset specificity	Equity in the joint venture (from Lafarge 75% share, Michelin 25% share) Members of the Sapphire board from Michelin and Lafarge No dedicated equipment, sites or personnel to Lafarge or Michelin from either party	No assets specific to Michelin Co-located to cement kilns so more difficult to switch to other end user Lafarge has tyre specific equipment and personnel, not Michelin specific	Dedicated site and personnel to Xerox for dismantling and recycling Xerox has own assets for remanufacturi ng IT industry often keeps value added 'asset recovery' in house	Bought all Xerox manufacturing assets in Venray (site, equipment and personnel)	No brand specific assets (OEM has dedicated personnel to ELV but not specific to contractor) Information system to track GM vehicle recycling rate.	No brand specific assets (OEM has dedicated personnel to ELV but not specific to contractor)
Role of data and information	JV board level information	Sales, planning and forecast information	transparent materials balance information and revenues	materials balance, recycling levels	IDIS information Feedback recycling level by weight	IDIS information Feedback recycling level by weight
Attitude to price change	Board level discussions of costs	Little influence over retailer collection payments	Transparent costs and profit	Limited open book systems	Will renegotiate if costs change (up or down) Based on cost changes at dismantler	Opportunity to renegotiation, free collection
R&D	NO specific input to or from design, not specific research activities as process pre-existing	Worked on chip quality for 3 years (but with Lafarge and not Michelin)	Minimal Feedback into R&D	No specific R&D in Flextronics for Xerox but linked to Xerox R&D facilities	R&D shared between OEM through CARE Some dismantling studies to assess costs	Limited dismantling studies
Routines for knowledge sharing	Shared personnel	Little scope	Based on developed capabilities over time	Took over all site personnel so transfers skills and knowledge	Knowledge sharing in the network part of the arrangement Transfer from dismantlers to OEM, on process issues/costs Small link to design studies	Knowledge sharing in the network part of the arrangement Transfer from dismantlers to OEM, on process issues/costs Small link to design studies

All the relationships studied across the cases showed a high level of information sharing including product designs, demands, distribution channel structure, material flows and revenues. However, depending on the relationship there were varying levels of input into the research and design process of the OEMs. Only in the case of Xerox and Flextronics was there a direct link to R&D, but only because Xerox engineers were present at the Flextronics site (which had previously been Xerox Manufacturing). The tyre case shows no input to the R&D process directly, although Michelin had carried out numerous studies into recovery alternatives. Equally, vehicle manufacturers had carried out many design studies based on dismantling efficiency, but there is currently no link between dismantlers and designers (except in isolated OEM driven design studies). GME participates in IDIS (a vehicle dismantling information system) that allows any dismantler equal access to information on vehicles, but this was criticised as often inaccurate and is not specific to the relationships.

Due to the high level of information sharing between the OEMs and the recovery service providers, disputes (in fact none were recorded) over price and capacity, as expected by respondents, would be dealt with in a non-adversarial manner. In the case of copiers, the costs for Covertronic's recovery of materials and parts were balanced by the revenues gained and so the price for the service was determined after an agreed margin level with Xerox. The agreement with Flextronics meant that the manufacturing/remanufacturing service was again based on margin levels based on Flextronics' ability to leverage economies of scale, although the Venray site was not cost competitive, the longer term strategy of Flextronics was to consolidate operations at a lower cost location in future. In the tyre industry case there were no cash transactions to negotiate, except for the returns on the equity stake. The GME contracts with Autogreen and Bridges allow for a renegotiation if metal market prices change (decrease).

7.4.3 The role of certainty and dependence

The impact of certainty (or rather uncertainty and risk) in the relationships is variable across the cases within this study. The joint venture formed in the tyre sector is a close linked governance form which enables an amount of certainty in the available skills and technologies that Lafarge and Sapphire offer. The main area of uncertainty was on the supply of tyres from retailers, based on the influence of Michelin, which in fact did not lead to a stable supply situation. Furthermore, Lafarge also began to experience consumption difficulties at the cement kilns, causing further difficulties in demand and supply that had to be managed by the JV Sapphire (by holding excessive stocks). In the case of copier machines, uncertainty was present in the form of variable revenues from material sales (Covertronic) and the ability to successfully maintain the divested Xerox remanufacturing operations (Flextronics).

Table 7-5 The role of Certainty and dependence

	Michelin Lafarge	Michelin Sapphire	Xerox Covertronic	Xerox Flextronic	GME Autogreen	GME Bridges
Certainty	Provided through the JV	Certainty maintained through the JV arrangement, sharing information about end user and tyre arisings, but limited	Revenue uncertain due to materials markets, supply side certain due to in house processes Share demand information	Certainty that Flextronics can continue the business profitably	Trust viewed as important Risks to reputation of OEM from Dismantler behaviour Uncertain development of legislation – affect the way relationship set up	Long term relationship Risks to reputation of OEM from Dismantler behaviour
Dependence	Dependency through the JV structure Lafarge could switch back to unreliable supply of before Not an industry level initiative	Michelin dependent on Sapphire to provide take back solution, no alternative could take all the volume (would be more complex alternative)	Only one contractor for dismantling, but could do in house	One main contract manufacturer in Europe. Other contractor globally. High dependence	Dependent on one contractor to coordinate and control the network performance (could change contracts with individual network sites)	Based on geographical location, so could switch if similar site close by

Both relationships had characteristically high levels of information sharing including open book accounting processes, so that unforeseen impacts on revenues could be managed effectively. One of the main areas of uncertainty from GME's perspective was whether the contractors would be able to comply with the law, and hence not damage GME's reputation. Trust was viewed as an important counter to this uncertainty, enabled through personal relationships that had been built up over the development of the legal framework. The fact that the legislation was delayed actually allowed more time for the relationships to build, especially between the prime contractor Autogreen and GME, despite introducing uncertainty in the contracting process itself (search, requirements specification, tender).

Dependency can be viewed as high for all the relationships in the cases. The tyres JV is partially motivated through the available capacity of Lafarge to deal with all Michelin's waste tyres arisings and as such switching to other recycling routes would limit the capacity available to Michelin. The investments in a JV mean that the 'lock in' effects of the relationship are high, thus it follows dependency is commensurately high. In the case of Xerox, both relationships are of a 'single source' type, i.e. there is not an immediate alternative to supplying these services – recycling and 'contract remanufacturing'. Conceivably Xerox could reintegrate these functions, but especially in the case of Flextronics, the scale economies that will be achieved through working with a large contract manufacturer are likely to far outweigh the benefits of integrating remanufacturing again. Dependency in the automobile sector case is again high, but driven by the legislative requirements and industry level consensus on how to respond. Here, two compliance organisations were established, Autogreen and Cartakeback, limiting the choice of service providers that OEMs could contract with. The other network partners, that are part of this value chain, are geographically dispersed and again legal constraints mean that OEMs have limited choice over who they can contract with, raising the level of dependency.

Mutuality exists in all the cases, but again can be viewed as variable. Xerox, Flextronics and Covertronic are all mutually dependent, due to specific investments in the customers (on the supplier side) and lack of choice of alternative supply on Xerox's side (customer side). Within the end of life tyre case, the very existence of the joint venture implies mutuality through shared risks (by way of equity stakes in Sapphire). However, despite the initial capital from Michelin, further benefits have not followed (see section 7.6). The case for mutuality is even less in the automobile case whereby GME requires a compliance scheme, it only has a choice of two, whereas Autogreen provides services to multiple OEMs. Equally, Bridges provides a needed service for GME based on geographical location but has multiple OEM 'customers'. Furthermore, the close relationship between GME and the ATFs studied implies that both contractors see benefits in contracting with GME through the improvement in visibility (GME provides large volumes) and credibility (contracting with a large MNE).

The characteristics of these relationships provide a partial explanation of the management of the capabilities that are discussed in the following section. The motivations for contracting are linked to available resources and capabilities at subcontractors, and the governance structures provide a means by which these capabilities are managed and in some cases developed. This is discussed next.

7.5 Capabilities for product recovery

The acquisition of capabilities for product recovery forms part of the reason for contracting within each of the relationships examined in this study. Identifying what capabilities are needed, searching for contractors that have these capabilities and managing a relationship to realise the expected outcomes (compliance to regulation at low cost for example) means that understanding the role of capabilities is inextricably linked to how relationships provide specific benefits. This section details the capabilities that pre-exist or in some cases developed and assesses their role in leading to expected outcomes.

Table 7-6 shows the comparison of capabilities that were developed from the coded data from each of the cases in chapter 6 and categorises each capability with respect to alignment between the partners based on Das and Teng's framework (as discussed in Chapter 2). Referring back to the research question, "*Do product stewardship capabilities develop from collaborative relationships and if so how do they develop?*" from chapter 4 it would appear that capabilities do develop, but are part of a larger set of capabilities that pre-exist and are acquired. These developed capabilities tend to be the result of firm's pooling their expertise in a particular area, to tackle a specific problem such as supply uncertainty.

Table 7-6 Cross case product recovery capability comparison

Firm	Capability	Inter partner capability alignment	
	Pre-existing	**Similarity**	**Utilization**
Michelin	**Pre-existing** • Marketing • Use position in the supplier chain • Ability to network to find expertise **Developed** • None	Low Low Low	Not performing Not performing Performing
Lafarge	**Pre-existing** • Ability to develop measures and technologies to support product recovery **Developed** • None	Low	Performing
Sapphire	**Pre-existing** None **Developed** • Ability to develop measures and technologies to support product recovery • Ability to control and coordinate the supply chain	Low Low	Performing Not performing
Xerox	**Pre-existing** • Influence design for product recovery • influence legislation • use position in the supply chain • Ability to develop measures and technologies to support product recovery • Ability to control and coordinate the supply chain • Build up processes over time • Create a customer focused program	Med	Performing
Covertronic	**Pre-existing** • Control and coordinate the supply chain • Introduce measures and technologies for product recovery • Create a customer focused program • Provide revenue to reduce compliance costs	Med	Performing

	▸ **Developed** • Introduce measures and technologies for product recovery • Use position in the supplier chain		
Flextronics	▸ **Pre-existing** ▸ None ▸ **Developed** ▸ **ACQUIRED:** • Control and coordinate the supply chain • Influence design for product recovery • Build up processes over time • Introduce measures and technologies for product recovery • Create a customer focused program	High High High High High	Performing
GME	▸ **Pre-existing** • Influence design for product recovery • Marketing • Influence future legislation ▸ **Developed** • Influence future legislation • Re-establish customer link	Low	Performing
Autogreen	▸ **Pre-existing** • Provide revenue to reduce compliance costs • Introduce measures and technologies for product recovery • Build up processes over time • Network linkages for recovery ▸ **Developed** • Influence future legislation • Provide revenue to reduce compliance costs • Build legitimacy • Marketing	Low	Performing
Bridges	▸ **Pre-existing** • Provide revenue to reduce compliance costs • Introduce measures and technologies for product recovery ▸ **Developed** • None	Low	Performing

7.5.1 Pre-existing capabilities

The analysis of the pre-existing capabilities first focuses on the common ways in which resources are mobilised to achieve product recovery. This is followed by a discussion of idiosyncratic capabilities that form part of the recovery processes.

7.5.2 Common capabilities across the cases

At the OEM level there were a number of common capabilities identified from the case data. The ability to influence the design of the product means that for Xerox and GME, learning from the dismantling and recycling processes (carried out internally through design studies) would feedback into the design of the product. Design for product recovery is integrated into the normal design cycle of products. This is not the case for tyres, whose integral, homogeneous structure means that dismantling is not possible, and recovery involves treating the complete product (chipping and consumption in cement kilns) with no input into the design to make this a more efficient or effective process of recovery.

The ability to influence legislation (although to limited effect) is a socially complex activity that requires the communication and proactive lobbying with a variety of stakeholders, often in conjunction with competitors and other members of the product recovery supply chain (this aspect could weaken the positive effects on competitiveness, as benefits are shared across competitors). Although a pre-existing capability, in the case of GME, it was considerably strengthened by working closely with Autogreen in the government consultation process.

A third common and socially complex capability is the ability to use the position in the supply chain. This was used to the advantage for Michelin in order to ensure retailers used their recovery 'partner' Sapphire, although in fact this coercion was not always effective, as retailers often used the best price offer (in some cases, competitors to Sapphire). Xerox was also able to use its position in the supply chain to ensure that leasing agents and operating companies always brought end of life product back to Xerox in the systems that it provided, to maximise return supply. A fourth common capability was the ability to use marketing to raise the profile of the recovery system with last users. Both GME and Michelin were able to utilise marketing resources to improve the visibility of the recovery operations to last users.

The introduction of measures and technologies to support product recovery reside within those companies that either provide specific services for recovery or for internal reasons have developed them alongside their 'normal' business process. Examples include Covertronic who have introduced technologies for recycling plastics and measures for achieving high recycling levels and the automotive 'authorised treatment facilities' who have invested in depollution rigs and storage facilities for end of life vehicles. Each specialist has years of experience in using these technologies to minimise costs and maximise revenues, based on understanding complex processes and utilising tacit knowledge of re-use and recycling techniques as well as markets for the products of these activities (parts and materials). Both Xerox and Lafarge have adapted their complex new product processes to integrate end of life products, building on considerable expertise in process control and innovation (especially in the case of Xerox who are known for their innovative organisational developments such as TQM).

In contrast to the similarities on pre-existing capabilities across the cases, there are also a number of capabilities that are specific to particular cases. For example, from the

OEM perspective, Xerox is the only company that has integrated a full product recovery operation including remanufacturing activities.

7.5.3 Distinctive capabilities

The identification of distinctive capabilities brings the argument back to previous discussions of the resource based view and how specific assets and idiosyncratic investments can lead to differentiation between firms and therefore competitive advantage. As discussed in section 2.2.3 it is the identification and utilisation of these capabilities that provides their competitive edge. Furthermore sections 3.4.1 and the synopsis of the literature review in section 4.2, show that in the area of product stewardship and product recovery in particular the literature lacks description of these types of assets and how they are utilised.

Xerox shows specific capabilities that allow it to profit from the product recovery process and not only minimise the cost of compliance to expected legislation (i.e. the WEEE Directive). Through a long term strategy of integrating product recovery in its operations Xerox is able to maximise the value of returning end of life product to the market into order to gain extra revenues over and above its new machine revenues. Technologies and processes are in place to meet high quality standards and to react responsively to market demand without excessive cost. In addition this, Xerox has also been able to leverage the control and coordination of the supply chain through linking this activity to the Supply Chain business unit that has particular specialities in managing the flow of goods in the value stream (sophisticated IT for tracking and tracing, online databases of products, communications technologies to transmit requirements information to geographically dispersed engineers and supply chain partners). Furthermore, the customer focussed approach has tailored the product recovery process to the needs of customers (convenience of collection of end of life consumables for example through specialised packaging). The use of these resources to obtain a profitable business model are based on *'years of doing it'*, by building up competences over time that cannot be easily replicated (unless completely acquired with potential losses of assets and knowledge), are socially complex (coordinating supply and distribution partners) and often based on tacit knowledge (new ways of managing the flow of returned goods in the asset recovery centre and improving quality standards).

By contrast, the other OEMs use their relevant skills in marketing and position in the supply chain in order to enable the service providers to operate the product recovery service more effectively (by raising the credibility and visibility of the process and attempting to coerce retailers to use one service provider).

On the side of the service providers, the other distinctive capabilities were Autogreen's established links in the recovery network and extensive managerial experience of the industry and Covertronics experience of managing the complex network of purchasers (for materials and components) and ability to produce a customer tailored project. Autogreen developed out of the dismantlers' own industry association and thus is able build on existing relationships and knowledge of how the industry operates (socially and politically). This shows characteristics of a socially complex capability built up over time.

Using a resource-based theory of relationships (Das and Teng 2000) it can be seen that the capabilities represented here can be assessed using the framework of capability alignment. Using this framework highlights that in terms of similarity, most of the capabilities across the cases have low similarity and therefore would not imply replication, but complementarity. This is with the exception of Flextronics that has acquired the capabilities previously owned by Xerox (sites, equipment, personnel with knowledge of Xerox remanufacturing systems) and also to an extent Xerox (who now shares similar operations with Flextronics and Covertronic – where basic disassembly occurs). Both these capabilities however are seen as performing in that they meet the expectations of lower manufacturing costs (Flextronics) and increased revenues (from the sale of components by Covertronic). The capability that is perceived as not performing is a result of Michelin not being able to influence its franchised retailers (ATS) to use only Sapphire through its marketing and use of supply chain position. Therefore Sapphire is not able to fully utilise its developed capability to control and coordinate the supply chain (e.g. stabilise supply of end of life tyres from retailers).

7.5.4 Developed capabilities

In the cases where the development of a specific capability was the aim of the relationship, joint efforts were made to provide the necessary inputs (information on demand, knowledge of designs, etc). For example with the joint venture for the recovery of end of life tyres, Michelin and Lafarge purposefully set out to provide knowledge about recovery processes and distribution channels respectively. In the case of

Covertronic, Xerox specifically worked with Covertronic to develop ways of maximising the recycling level of end of life copiers, such as developing a closed loop supply chain for ABS plastic. In the case of Autogreen, there was evidence that they had worked closely with GME to lobby the DTI, to ensure that a favourable interpretation of the end of life directive was made by government. With the help of GME, Autogreen then developed a brand and marketing material to sell the concept to other OEMs.

7.5.5 Summary

Linking back to established literature on product stewardship and capabilities, Hart (1995) proposed capabilities that would be expected to support product stewardship (including product recovery). Hart's 'stakeholder integration' capability that leads to legitimacy can be thought of as comprised of the elements of collaboration where contractors are integrated through the sharing of information and knowledge not only in the R&D process but the actual product take back process as well which could be thought of as equally socially complex. Yet Hart (1995) does not mention suppliers (service providers) as being important to this process. Hart (1995) views shared vision across supply chain partners as a function of the relationships that have been set up, so that the collaborative nature of the relationships is reliant upon setting mutually shared goals (low cost processes, increased revenues or simply compliance as demonstrated in these cases). Whether this is always of competitive value can be questioned by this research, especially when the shared vision is between OEMs at the same level of the supply chain e.g. vehicle manufacturers who have a shared vision on how compliance to the ELV directive should be met. Hart views shared vision as being essential to sustainable development but not product stewardship, yet this research suggests it is an important aspect of a product recovery strategy.

The competitive value of product recovery capabilities: the influence of firm or relationship-specificity

There were two examples of firm specific capabilities in the cases studied. Lafarge are able to use tyres in their kilns in a way that not only complies with regulatory norms but actually reduces the cost of compliance to those norms (this has to be balanced against the potential negative impact of public perception and hence legitimacy). Xerox, on the other hand, are able to recover products from the market and then remarket these products to the same standard as new products through the application of advanced remanufacturing processes (that Flextronics has been able to acquire but only by taking on a complete Xerox site, assets and personnel including their knowledge of Xerox systems and processes). An important issue is whether if Xerox successfully transfers its manufacturing to Flextronics will it do the same with remanufacturing, only retaining a supply chain coordination function.

Relationship specific capabilities are also present, for example the Xerox contract with Covertronic, whereby a site specific investment to recycle plastic from copiers led to a closed loop process that provides a cheap input to manufacturing of new copiers , while at the same time avoids landfill. This is also the case for Michelin and Sapphire, whereby the ability to control and coordinate the supply chain was gained through knowledge of, and influence over, Michelin's distribution channels. Although this capability was put in place it was found not to be performing as expected (not reducing supply uncertainty), partly due to uncertainty over legislative plans (who would ultimately be responsible for the take back of tyres?).

7.6 Outcomes (organisational and ecological)

The following section analyses the occurrence of benefits (positive outcomes) of the relationships that were examined in the case studies. Akin to Khanna et al's (1998) private and common benefits, the organisational benefits are shown to represent benefits only one firm realises or both in the relationship are able to obtain. Furthermore the importance of the benefits is indicated (high, medium, low) based on the frequency with which they are mentioned in the data. The section ends with a judgement of outcomes that were not viewed as beneficial.

It should also be noted that these collaborations did not always achieve the expected benefits foreseen by the firms at the outset. Although the research questions did not seek to specifically explore negative sides of the relationships, the data collection and interviews were sufficiently flexible to allow such issues to arise when apparent. Therefore the outcomes of the cases are discussed both in relation to the benefits and also those expectations that were not realised.

7.6.1 Organisational benefits

Table 7-7 Organisational benefits from the case study relationships

Organisational Benefits
Tyres

Relationship	Michelin	Lafarge	Sapphire
Michelin Lafarge	Improves reputation (low) Compliance (low) Reduces risk (medium)	Reduces cost (medium) More efficient process (medium) Improves flexibility (medium) Compliance (low)	-
Michelin Sapphire	Improves reputation (medium) Reduces risk (medium) Compliance (low)	-	Increased revenue (medium) Reduces cost (low) More efficient process (not achieved)

Copiers

Relationship	Xerox	Covertronic	Flextronics
Xerox Covertronic	Improves reputation (medium) Increases revenues (low) Improves flexibility (low) Reduces costs (low)	Increases revenues (medium)	-
Xerox Flextronics	Improves flexibility (medium) Reduces costs (medium)	-	Increases revenues (medium)

Automobiles

Relationship	GME	Autogreen	Bridges
GME Autogreen	Low cost compliance (high) Re-establish Customer relationship (low)	Legitimacy for dismantlers - licence to operate (high)	-
GME Bridges	Low cost compliance (high)	-	Legitimacy for dismantlers - licence to operate (medium)

7.6.2 *Shared benefits*

Two cases demonstrate benefits that are shared across the parties to the relationships. Michelin and Lafarge both have compliance issues to meet whereby Michelin managers had originally believed that producer responsibility was likely to mean Michelin would be responsible for take back of tyres in the UK, and Lafarge was looking for an alternative to coal for a kiln energy source, in order to make compliance easier (due to lower regulated emissions from tyres used as fuel). In fact, Michelin has not been made responsible for tyre take back, and so the benefit is only for a potential development in the future of UK legislation (which in the view of Michelin is worth acting on now).

The second example of shared benefits is in the Xerox case with Covertronic. A new revenue stream has been developed through the stripping of end of life copiers of their components which can then be sold. Through the joint planning of end of life copier treatment, both Xerox and Covertronic are able to maximise the yields from the copiers that cannot be remanufactured. The open book approach ensures that revenues are shared across the firms as agreed contractually.

These shared benefits however, could be viewed as relatively low level. The compliance benefits have little impact on Michelin's current business and the impact for Lafarge is mainly in lower costs of compliance (the emission licence charge is lower due to lower emissions). If viewed in terms of legitimacy, the negative publicity of using tyres in kilns could be of higher importance and ultimately mean a revocation of the laws allowing tyre incineration with current technology. The shared revenue benefits of the Xerox-Covertronic relationship are also at a low level compared to the overall turnovers of these companies[33].

7.6.3 Individual benefits

The cases showed that it was far more prevalent for benefits to accrue individually from different sources, than to be shared across the contracting partners. The key individual benefits accruing to the OEMs are linked to lower costs and compliance (or both in the case of GME). The automobile case is driven by the need to achieve low cost compliance to the ELV directive and the relationships set up ensure this is the case (where materials and parts revenues outweigh the costs of treating and dismantling vehicles). For Xerox the reduction in costs to meet the 75% recycling target is partially met through avoiding landfill cost but also through revenues such as re-using materials in house (for copier casings and toner bottles – up to a maximum of 20%) and as well as selling parts (shared with Covertronic).

Improved reputation (as perceived by the respondents) and legitimacy are also important, if intangible, benefits. This is supported by Michelin and Lafarge (although this could be questioned given public disquiet about using tyres in cement kilns) and Xerox in terms of meeting perceived social expectations on environmental performance (increased recycling levels and legislation). The service providers also report improved reputation through association with large MNEs, building their credibility to win new business and looked on favourably by compliance inspectors. Interestingly both Michelin and GME report that a 'green' reputation is not important to their customers, especially in the area of recycling which is low on consumers' 'buying criteria list'.

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[33] Xerox metal scrap levels of 778T (July – Nov 2003) would lead to an approximate income of £17000 per three months (@£22/T), the total income from all parts and material revenue was £150,000 in 2003

Furthermore, flexibility was seen to increase for Lafarge due to choice between which sites consumed tyres (the demand fluctuates due to variations in process) and also for Xerox where fixed costs for personnel had turned to variable costs for remanufacturing and dismantling of copiers and parts. There is evidence that risk to Michelin is reduced in terms of legislation forcing new responses that had not been planned for (although this again could be questioned if incineration of tyres is less favourable in future). GME reports that it is possible that new links to the customer could be forged through the introduction of a GM product discount voucher for end users returning GM vehicles to Autogreen and also potentially re-marketing branded used parts. The efficiency of product recovery in the tyre case is also reported to improve through the relationships whereby logistics processes are improved through new chipping technology and better geographic location (closer to end users), as well as the economies of scale of using a number of large Lafarge cement kilns for consumption (a smaller cement provider would have yielded lower demand).

7.6.4 Benefits not achieved

Relating back to the original goals of the relationships, one case stands out as not meeting expectations. This is the joint venture between Michelin, Lafarge and resulting in Sapphire. The link between the JV company Sapphire and Michelin was intended to reduce the uncertainty of supply from the distribution channel through which end of life tyres return by the coercive influence of Michelin. In reality this did not occur as retailers including ATS (the Michelin franchise) use tyre collectors who charge the lowest collection fee ("*as long as it's legal*" Michelin manager). Despite this, Sapphire has managed to grow a business that manages 85,000 tonnes of tyres (around 20% of the total scrapped in the UK annually and growing), meeting the goal of the equivalent of all Michelin tyres sold in the UK.

7.6.5 Ecological benefits

The following table outlines the ecological benefits found across the tables linking to national targets for recycling as well as internal company policies.

Table 7-8 Ecological benefits from the case study relationships

Product industry	Ecological benefits
Tyres	• 85,000 Tonnes processed in 2003 (130,000T planned for 2004)

	• 20% of all UK tyres processed, equivalent to Michelin total sales • Helps UK reach 100% landfill ban in 2006
Copiers	• 39,000 copiers returned, 9750 remanufactured, 9750 used for spare parts and remaining recycled • Meets the Xerox internal target of 75% recycling of returned product (actually achieved 95% July-Nov 2003). • Meets expected recycling target of WEEE Directive (75%)
Automobiles	• Current recycling level of 81% of cars received recycled (metal and depollution materials - tyres, batteries, fluids) • Complies with legislation at present (free take back) • Uncertainty over meeting 85% and 95% recycling/recovery targets

The overall rationale for setting up new relationships for product recovery tends to be in order to meet new regulatory requirements on waste e.g. to meet recycling levels or to avoid landfill for certain products. In the case of Xerox this objective exists in tandem with competitiveness motivations for increased revenue (through its remanufacturing programme). Hence the ecological benefits are primarily related to meeting regulatory norms such as the ban on landfilling tyres in 2006, the requirement to recover 75% (65% recycling) of waste IT equipment, and the requirement for vehicle producers to provide a free take back service for last car owners, and support meeting recycling targets set for 2006 and 2015. Table 7-8 shows all the relationships allow for parts of the legislative requirements to be met, with only Xerox actually exceeding them at present. Michelin, although not subject to producer responsibility, would be able to meet expected obligations in future with this system. GME is also able to meet its obligations for free end of life vehicle take back, yet there is no evidence to suggest that the recycling target of 85% for vehicles will be met in 2006.

7.7 Conclusion

The question to be addressed by this research specifically relates "*how do collaborative relationships between firms, formed due to ecological pressures for producer responsibility in end-of-life product stewardship, provide capabilities that lead to organisational and ecological benefits?*" The cross case analysis has examined the elements of the research question by addressing the ecological pressures (and associated drivers), detailed the actual collaborative relationships that were formed, assessed the capabilities that each party brought to the relationships and examined the benefits that have accrued from combining and developing capabilities for product recovery specifically.

With respect to the drivers, all the cases are influenced by direct legislation (or the threat of legislation) for producer responsibility. Depending on the contextual picture, firms have viewed this as more or less of a competitive area that provides revenue benefits. Legislation also has competitiveness implications, but relates to reducing the cost impact of responsibility for take back and recycling.

OEMs have not traditionally viewed end of life product recovery as part of their core operations (warranty returns exist, but rarely end of life product returns). Only in the case of Xerox had any kind of end of life product recovery process been implemented. Typically OEMs have contracted (or joint ventured) to gain access to specific product recovery services (logistics, collection, depollution, dismantling, material and parts reuse and recycling).

The cross case analysis reveals that the collaborative relationships involve long duration contracts, with the opportunity to renegotiate with changing market conditions i.e. material prices. There is significant information exchange on distribution channels, demands and forecasts, product design (constituent materials and dismantling guidance). The Xerox case is characterised by knowledge exchange facilitated through shared site operations and divestment of operations (through Flextronics). The specificity of assets is high in both the tyre and copier case, but only through equity stakes in the former and sites, personnel, assets and skills in the latter. A high level of information exchange at many levels prevents opportunism in these relationships between Xerox and Michelin and their 'partners'.

The capabilities for product recovery are largely held by the recovery service providers: Lafarge, Sapphire, Covertronic, Flextronics, Autogreen and Bridges. OEMs contract with these service providers in order to gain access to the resources utilised by the contractors. In tandem, OEMs provide resources such as product design knowledge, knowledge of distribution channels and in the case of Xerox, a whole suite of capabilities that allow product recovery to successfully provide compliance (broader legitimacy in terms of meeting internal policies) and revenues. Both the tyre and automobile cases show instances of low capability similarity, making a case for combining them. Yet, in the tyre joint venture, the capability for using the position in the supply chain, whilst viewed as important, was not found to be performing as expected. Within the photocopier case, there was some similarity in capabilities e.g. ability to develop measures and technologies, but careful partitioning of tasks avoids duplication (e.g. differentiating recovery measures between remanufacturing and recycling). Interestingly, Xerox is following a trend of outsourcing manufacturing where further divestments of remanufacturing are possible (even likely). The close relationship with Flextronics has meant quality and ecological standards remain constant, despite outsourcing. There is only one example of a relationship specific capability that supports product recovery and this is between Xerox and Covertronic, whereby exceeding legislated recycling levels, generates revenue and low cost raw materials through the combination of Xerox's design and process knowledge and Covertronic's experience of trading with electrical/electronic parts and materials markets. In order to understand whether capabilities are truly performing it is important to assess the outcomes or benefits of gaining access to, acquiring or developing capabilities.

The outcomes from each case are examined from both organisational and ecological perspectives. Furthermore the organisational benefits can be viewed as shared across organisations or accruing to a single organisation only. The shared benefits include those between Michelin and Lafarge which both achieve compliance in terms of expected producer responsibility and lower costs of emission licences. The Xerox – Covertronic relationship literally provides shared benefits through the revenues from parts and material sales. The individual benefits from the relationships range from lower costs for compliance through waste charge avoidance and waste sales revenues. Reputational effects, building legitimacy, are perceived to improve in relation to a variety of stakeholders including legislators and customers (in this case for service providers). Process improvements are also reported through increased flexibility and efficiency. Yet, not all outcomes are positive. The more efficient process of acquiring tyres did not materialise for Michelin, Lafarge and Sapphire despite potential influence over the retail channel. Interestingly, the most collaborative type of relationship (a joint venture) does not necessarily perform any better than other collaborative forms. The analysis revealed that the combination and development of capabilities does not necessarily lead to the expected outcomes. It may be more useful to re-classify these capabilities as non-contributory or non-performing as they do not result in the firms realising their expected benefits. The reason for these non-performing capabilities can be traced back to the relationships themselves whereby mis-understanding of the role of a partner leads to a mis-match in expectation. In hindsight, the original intention for the JV between Michelin and Lafarge was not met and if Sapphire had existed without the capital and resource injection of Michelin it may have led to same situation as today[34]. This is a particular problem to be faced when pre-empting legislation (a characteristic of ecologically proactive firms) and is an important risk to be identified early on.

Chapter 8 discusses the analysis of the three cases, six relationships and nine organisations. The research question and sub-questions are examined through the outcomes of case analysis and the conceptual framework is re-visited, reflecting back on the literature.

[34] The author has since learnt Sapphire directors have bought-out the Michelin equity stake in Sapphire

Chapter 8 Discussion

8.1 Introduction

This chapter links the analysis of individual cases and across the cases (in chapters 6 and 7) to the background literature (chapters 2-3) and the conceptual framework (chapter 4) in order to bring an understanding of collaborative relationships for product recovery as a process and a means of achieving a specific outcome. The chapter re-iterates the research question and constituent sub-questions and provides answers based on the analysis in the previous two chapters. The conceptual framework is then re-visited in the light of the answers to the research questions. The analysis suggest a re-working of the conceptual framework and this is re-presented showing the main differences arising from the research. In order to fully express the implications of the findings, a process view is taken of the role of collaboration for end of life product stewardship. This allows the initial development of a conceptual model that integrates the discussion of literature and the empirical findings of this research.

8.2 Response to the research questions

The research aims to answer the following question:

> *How do collaborative relationships between firms, formed due to ecological pressures for producer responsibility in end-of-life product stewardship, provide capabilities that lead to organisational and ecological benefits?*

In order to provide a complete answer to this question, a number of sub-questions were developed (See Section TwoChapter 4). These sub-questions are discussed in light of the analysis in Chapter 7.

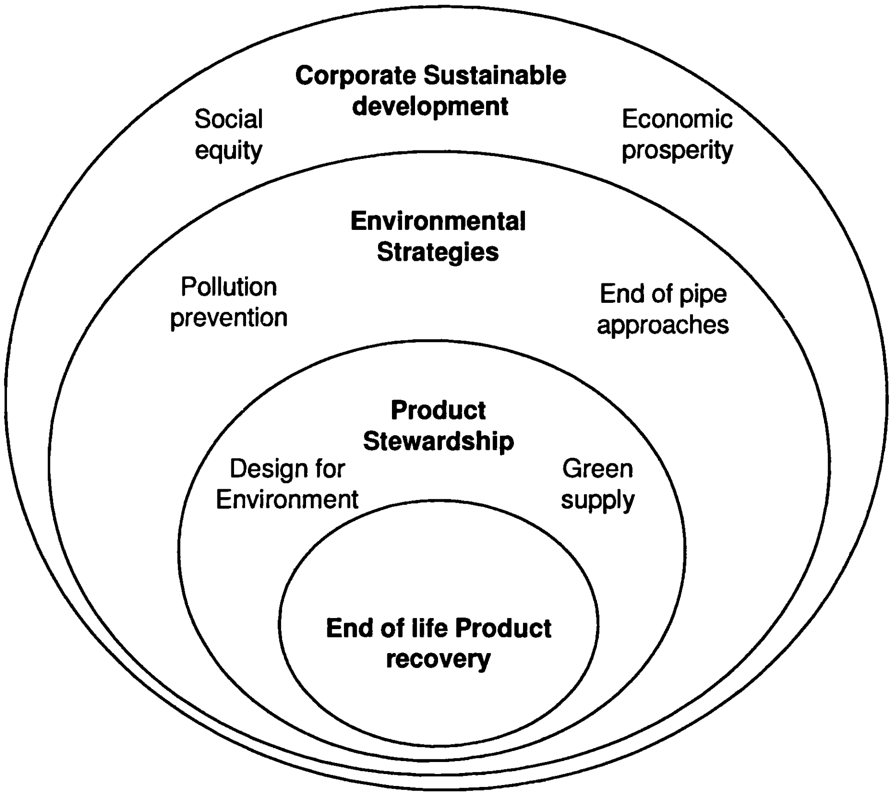

Figure 8-1 Product recovery as part of Product stewardship

In order to clarify the position of end of life product recovery with respect to product stewardship in this thesis, figure 8-1 shows the concept as a sub-set of product stewardship. Product stewardship itself is situated within the domain of general environmental strategies defined by Hart (1995) as also consisting of pollution prevention and sustainable development, more recently conceptualised as incorporated within corporate sustainable development, as reflected here (Bansal 2005).

8.3 The research sub-questions

The analysis uncovers a set of answers to the research sub questions, by addressing how the cases individually and as a group provide supporting and refuting evidence. A brief return to the contextual factors including the pressure for adopting product recovery provides further validation of earlier findings in the literature. Specifically, the over-riding influence of actual and planned legislation cannot be ignored (Carter and Ellram 1998; Pohlen and Farris 1992; Stock 1998). The research supports Bansal and Roth's (2000) assertion that ecological responses are motivated by the need for legitimacy and competitiveness often in combination, by motivating compliance to new regulations (automobiles and tyres) and providing new green products/services (copiers). Further support to previous models is given by the lack of evidence for ecological responsibility as a motivating factor for product recovery actions. Bansal and Roth (2000) expect donations and unpublicised actions to flow from ecological motivations (based on individual manager concerns and ethical viewpoints), and not product stewardship type activities. However, the evidence from the cases shows that firms are not motivated exclusively by legitimacy or competitiveness, but in fact by a mixture of both to varying degrees, and this is reflected in their responses through the collaborative relationships that are set up. These motivations are an important explanatory factor in how the collaborative relationships benefit firms as shown later. This discussion continues with a treatment of each of the research sub-questions.

8.3.1 Research sub question One

What form do relationships for end of life product recovery take and to what extent are they collaborative?

The initial relationship network mapping exercise for each of the three cases was intended to identify the relationships that currently exist and are being developed for end of life product recovery. Network diagrams were constructed for each case to identify the OEM's main relationships for product recovery, and from these maps, to isolate two relationships that were collaborative, in order to pursue further research. The case analysis found that collaborative relationships centred round service provider specialists that were able to provide resources (assets, skills, technology) to recover products either as mandated through current or impending legislation, or to meet internal targets (e.g. an internal policy for achieving specific recycling levels). The following figure (Figure 8-2) shows a generic relationship map for the cases, showing the extent of relationships for product recovery. The cases showed a number of common structures in terms of the network of relationships. All the OEMs had interactions with government both at the UK level (normally the Department of Trade and Industry) and also at the EU level, where the drive for producer responsibility legislation often starts. These relationships tended to be either formal communications on consultation documents or direct lobbying either individually as firms or through industry groups (or both). The product manufacturers also held relationships, to differing degrees with 'supply chain' firms such as service providers including logistics and recycling service providers. Not all OEMs had direct relationships with the source of end of life products e.g. final users, in fact out of the cases only one company, Xerox, had this kind of contact. Other OEMs maintained this contact either through independent retailers or franchises.

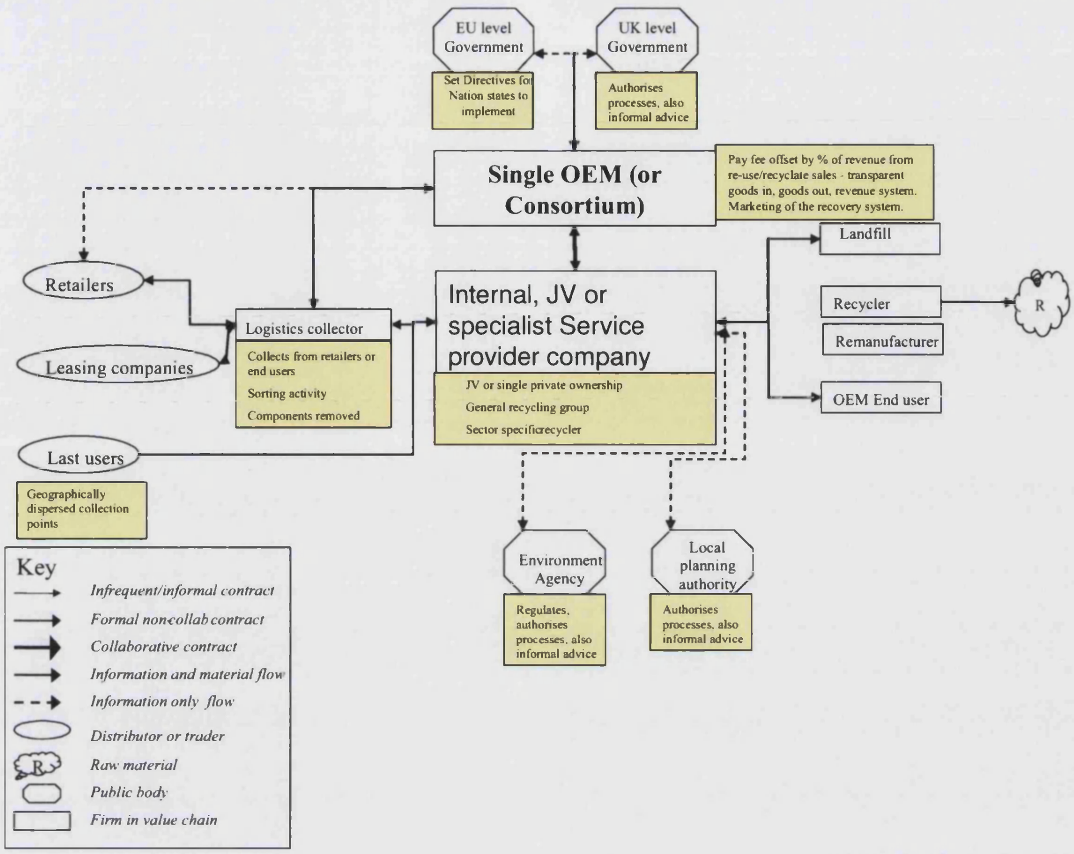

Figure 8-2 Generic view of the network of relationships for product recovery based on the cases

The specialists depicted in the chart were not necessarily recovery service specialists, for example Lafarge operates a process that provides a recovery route for tyres, but this is incidental to their core business. This is a new contribution to knowledge in this area whereby previous network maps have only shown recovery specialists (Prahinski and Kocabasoglu 2006). This addition of Lafarge adds a new dimension more related to Industrial Ecology ideas of symbiotic relationships. In another example, contract manufacturer Flextronics took over recovery operations from Xerox, yet this had not been a specialism in the past for Flextronics. In addition, to these exchange based relationships, OEMs also maintained relationships with other stakeholders such as government (local, national and supranational), industry bodies (SMMT, BLIC, INTELLECT, ICER, etc)[35] and other OEMs through take back consortia, research consortia or through the industry bodies, as mentioned in other studies (Thierry et al. 1995; Toffel 2002). These relationships influence the product recovery process and are

[35] See Glossary of terms

based on less formal 'social' contracts and are an additional means through which legitimacy is gained (supporting Hart's (1995) 'integration of stakeholders' capability).

The extent of collaboration is examined in the analysis of the relationships' collaborative characteristics. The relationships were analysed using a framework of dimensions based on Lamming (1993), Cousins (2002) and Min et al (2005), and included the following dimensions: duration, modes of governance, reason for sourcing, complementary resources, asset specificity, role of data and information, attitude to price changes, routines for knowledge sharing, R&D, certainty and dependence. More recent research into 'close' or 'partnership-like' relationships has shown these dimensions to be valid indications of collaboration (Goffin et al. 2006). The two dyadic relationships chosen for each case were collaborative based on longevity and governance modes with significant exchange of information. Interestingly the asset specificity in terms of sites, personnel and dedicated assets were relatively low (with the exception of Xerox relationships) meaning that they could be transferred to other uses (customers) without significant losses. Instead, the assets tend to be industry specific, dealing with particular products - i.e. tyre chipping equipment or vehicle depollution rigs can be used for any tyre or vehicle brand - and not relationship specific. This is consistent with thinking in the field that boundary choices, when acquiring new capabilities, are dependent on the implications for transaction costs where high asset specificity is likely to lead to integration (Jacobides and Winter 2005).

Integrate	Collaborate	Market transaction
Firm / relationship specific assets	Industry specific assets	Non specific assets
• Design activities	• Depollution	• Logistics (product collection)
• Remanufacturing	• Recycling	
• Refurbishment	• Remanufacturing	
	• Refurbishment	

Figure 8-3 Depiction of the relationship form and type of operation for each of the relationships

As the previous figure shows (Figure 8-3) linking the examples from the research to the type of relationship as conceptualised in the literature is not a straight-forward process. To distinguish between the cases it is useful to view the operations to which each one is related, so that each case comprises more or less of the product recovery process overall. The figure shows that on the one hand the OEMs integrate functions such as design for recovery - commonly referred to design for the environment (DFE) in the literature (Pujari et al. 2004; Seitz and Peattie 2004) - but with the exception of Xerox, taking back and treating (sorting to disposal) is dealt with more or less collaboratively with service provider specialists. The case evidence suggests that the reason for Xerox integrating so many of the product recovery processes is due to the customer focussed approach to product recovery itself. Interestingly though, Xerox has sought to divest itself of manufacturing facilities and now outsources some recovery operations, that are customer –focussed, to Flextronics. This follows a general trend in electronics manufacturing to use established contract manufacturers in order to reduce manufacturing capacity.

Table 8-1 Table ranking collaborative relationships along four dimensions

	Xerox - Flextronic	Xerox - Covertronic	Michelin - Lafarge	Michelin - Sapphire	GME - Autogreen	GME - Bridges
Duration (yrs)	5	2	3	3	10	10
Knowledge sharing	high	high	low	med	med	low
R&D	yes	yes	no	no	no	no
Info sharing	high	high	med	med	med	low

Referring to Table 8-1, one of the most significant points in terms of differences is that collaboration can be based on long term commitments (i.e. 10 years), and yet show lesser degrees of knowledge sharing, R&D involvement and less information sharing. Hence collaboration needs to be viewed across a number of dimensions as seen here. It is the 'more or less' collaborative nature of the relationships that is of interest here, and how they lead to access to or development of capabilities for product recovery. Both the Xerox relationships appear as most collaborative, mainly due to the relationship being very specific to the Xerox product. End of life product recovery at Xerox requires company-product (i.e. Hodakar series and Silver Series photocopiers) specific processes, knowledge and information and input into R&D. The other cases are specific at the level of the industry (i.e. tyres or cars) and processes are only specific to that level. This supports Toffel's (2003) proposition that high asset specificity will lead to integration in the presence of uncertainty in transactions. However, this is not as straightforward as Toffel suggests, whereby Xerox integrates some specific processes and not others (see figure 8-1). Furthermore, the GME and Michelin relationships are motivated more from a compliance perspective (threat of or actual legislation) and these could be viewed as less collaborative. This supports Daugherty et al's (2003) view that if reverse logistics relationships are mandated (driven by legislation), they are less likely to require trust and commitment to be effective i.e. there is less need to be collaborative.

The role of uncertainty in the relationships appears to be significant in the way product recovery is organised. The collaborative nature of these relationships is characterised by a need to reduce uncertainty in a number of forms including quantity, quality and timing of returns as supported by the literature (Fleischmann et al. 2000; Nunen and Zuidwijk 2004; Pujari et al. 2004). Re-examining Carter and Ellram's (1998) framework highlights the point that their view of uncertainty only refers to its effect on the quality of inputs to the OEM i.e. uncertainty in the recycled materials used in new products will lead to vertical integration, and their framework only suggests that this could be the case for the output side. This research confirms that uncertainty over input is reduced through integration (Xerox is a case in point where they fully integrate the process of parts re-use). This research also suggests this argument can be equally applied on the output side of OEMs (return of end of life goods). This suggests a revision of the Carter and Ellram (1998) framework. Nunen and Zuidwijk (2004) claim that the implementation of sophisticated ICT should also allow the reduction of uncertainty, which is supported by the Xerox case which utilises shared DRP systems. This is not the only means however, and having close links through other integration forms (retail franchises between Michelin and ATS) is also aimed at uncertainty reduction, even if this ultimately fails.

8.3.2 Research sub question Two

What are the capabilities needed for product stewardship in the area of end of life product recovery?

The OEMs possessed a specific set of capabilities that were a function of their influence over the product, channels to market and impact on other stakeholders. These were found to be: influence design for product recovery, influence legislation, marketing, use position in the supply chain and the ability to network to find expertise.

The common capability from the OEM side is the ability to influence the design of the product. This capability maps directly onto Hart's (1995) conception of DFE, an integral part of end of life product stewardship. In the case of Michelin, the design of tyres has not been modified to fit with the recovery process although Michelin generically search for 'greener' solutions to tyre materials. Both Xerox and GME have sophisticated design for environment processes that are integrated into the new product development process. Internally cross functional activities – between purchasing, design and E,H&S departments – is consistent with expected internal processes to allow product stewardship again referring to Hart (1995). Yet, the cases show little input from the service providers into the R&D process, implying an information only input (based on pilot studies of dismantling) and limited input on the recycling of materials (e.g. Xerox's closed loop process for plastic). Therefore there is limited evidence (from the cases) for interorganisational activities in this area (also supported by secondary interview data), although sharing design related information may be more apparent on the upstream side of the supply chain, into OEMs, as other authors argue (Jackson and Ostrom 1980; H. Min and Galle 1997; Norris 2001; Pujari et al. 2004; Weinburg 1999; Zsidisin and Siferd 2000).

Another important capability is the ability to influence legislation, yet this is often an industry level activity. This could be thought of as Hart's integration of stakeholders. Although this is thought to build legitimacy, the analysis shows that in fact the aim is to minimise the risks from new legislation such as higher costs, which affects firms individually. Yet influencing legislation is carried out as a joint effort between competitors, removing potential individual benefits. However, the one example of GME-Autogreen shows how collaborating partners can attempt to influence regulatory design to reduce uncertainty, a point returned to later.

Table 8-2 Comparing the capabilities that emerged from this research and previous research on related capabilities

This research - **Product Recovery**	Previous research – **related concepts**
• Influence design for product recovery	Product Stewardship
• Influence legislation	• Design For Environment
• Marketing	• Stakeholder integration
• Use position in the supply chain*	• Cross functional team working
• Ability to network to find expertise	Green Supply Management
• Ability to develop measures and technologies to support product recovery	• Liaison between purchasing and other functions • Detailed purchasing policies and procedures
• Ability to control and coordinate the supply chain	• Partnership approach with suppliers
• Build up processes over time	• Technical skills of purchasing professionals
• Create a customer focused program	• Advanced understanding of environmental issues and how they affect supply
• Provide revenue to reduce compliance costs*	
• Re-establish customer link*	Previous research - Logistics
• Build legitimacy*	• Customer focus - Segment focus
	• Customer focus - Relevancy
	• Customer focus - Responsiveness
	• Customer focus - Flexibility
	• Information focus - Information sharing
	• Information focus - Information technology
	• Information focus - Connectivity

	(Hart 1995) (Bowen et al. 2001b) (Zhao et al. 2001)

* indicates capabilities not identified in other studies

Research into green supply management suggests that a partnership approach with suppliers (sharing risks and rewards) is a capability fostered by an ecologically proactive stance (Bowen et al. 2001b). This would include delegating responsibilities to suppliers and transferring key resources, knowledge and capabilities to the supplier. In fact, OEMs that are not seen as so proactive (GME in particular) also take this action of delegating responsibility purely because they are mandated to provide a take back process for last users. The process of determining what kind of relationship should be selected appears to stem from the chosen strategy of the OEM. In all the cases the service providers were chosen as partners because they offered a set of resources and capabilities to allow the appropriate disposition of the OEMs' end of life products.

The actual level of collaboration or 'partnership approach' would seem to be a characteristic of the process under scrutiny. In all the cases, levels of uncertainty meant that a high level of information, and in some cases knowledge, was required to ensure the process operated efficiently as well as meeting the process goals (as perceived by the parties to the relationship e.g. reaching compliance or recycling levels at zero net cost). Hence it would seem that the 'partnership approach' is a necessary by-product of an uncertain process in terms of the quality, quantity, timing of returned products as well as the expected performance of the contracted party, for example GME managers' perception of risks that vehicle dismantlers would act legally and also reach mandated targets. This is the case even when the process (including its resource elements of sites, personnel and dedicated assets) is not specific to the contracting firms. The relationships provide access to capabilities to reduce uncertainty by coordinating and controlling the supply chain as well as using the position in the supply chain (coercive power). This capability is found in all the cases, and although not always performing (as in the case of Michelin), appears to drive the collaborative efforts and is key to achieving the goals of product recovery.

There appear to be a number of other capabilities that are required to implement end of life product stewardship that are also leveraged through collaborative relationships with service providers. The cross case analysis showed that service provider parties to the relationships possessed the following capabilities: ability to develop measures and technologies to support product recovery, build up processes over time, create a customer focused program, provide revenue to reduce compliance costs, re-establish

(OEM's) customer link and build legitimacy. The development of measures and technologies was a common service provider capability where metrics and technologies were modified (if existing) or developed to fit the end of life product recovery process. These capabilities did not occur uniformly across the cases, but rather depended on the driving forces for taking up an end of life product recovery process. Furthermore, the development of these capabilities coincided with mutual targets to improve the processes themselves. Thus capabilities that were associated with a competitiveness oriented recovery process tended to relate to customer focus whereas processes with a legitimacy orientation related more to reducing costs of compliance and building legitimacy (credibility with legislators, potential users and other stakeholders).

Linking back to existing studies of capabilities in the fields of green supply, reverse logistics and logistics in general reveals a paucity of evidence to show which capabilities exist that support end of life product recovery. While table 8-2 shows there are some similarities in the capabilities identified in earlier research, this study adds to this area of reverse logistics and product recovery strategies (as a part of product stewardship). Specifically using the position in the supply chain, providing revenue to reduce compliance costs, re-establishing customer link and building legitimacy were identified as new capability categories that appear important for product recovery. This serves as an initial basis to address previous research gaps on how relationships aid reverse supply chains (see Prahinski and Kocabasoglu 2006 pg.528).

8.3.3 Research sub question three

Do product stewardship capabilities develop from collaborative relationships and if so how do they develop?

In fact there was relatively little evidence from the cases that capabilities actually develop from the collaborative relationships compared with the number that pre-exist in the firms. The JV arrangement between Michelin and Lafarge was intended to provide a development of capabilities for utilising Lafarge's current technological approach to consuming tyres in cement kilns and Michelin's knowledge of the tyre distribution channel in order to coordinate and control the supply of end of life tyres. In tandem with the new employees of Sapphire, these capabilities were developed over time. Covertronic worked with Xerox to introduce new measures and technologies to maximise recycling levels and revenues from product recovery. Autogreen worked with

GME to lobby government, build legitimacy for the business partially through GME's marketing resources, as well as developing a low cost compliance scheme for GME. The development of these capabilities appears to correlate with whether complementary resources are combined, such as GME's marketing ability and Autogreen process knowledge of the dismantling industry.

To précis, the capabilities that developed from the relationships were: a) the control and coordination of the supply chain which relied on both knowledge of the market (for recovered parts) and the recovery channels such as franchises and retailers, in combination with the OEM's influence over these channels; b) the development of measures and technologies depended on the combination of skills and knowledge of the product and process from both parties; c) marketing and influencing legislation again relied on combining knowledge of these fields utilizing the legitimacy of large MNEs and the working knowledge of the industry of service providers.

These developed capabilities supports Dyer and Singh's (1998) supposition that advantages can be gained from combining resources. However, unless these capabilities are specific to the relationship (the OEMs products and processes, such as in the Xerox case) the advantage is likely to 'leak' across to other contracting parties. This is a danger identified in the comparison of RBV and the Institutionalist view whereby firms "may be unwilling to rather than unable to imitate resources and capabilities when those resources lack legitimacy or social approval" (Oliver 1997 p.700). Taking this argument further implies that OEMs may be unwilling to contract with parties that have not gained legitimacy or social approval (in order to gain access to capabilities) which in turn limits choice. For example, where there is limited choice of vehicle dismantlers (only those contracted through a compliance scheme) the possibilities of advantages are reduced, as all OEMs contract with a limited set of partners.

8.3.4 Research sub question four

How do capabilities developed from collaborative relationships for product stewardship provide organisational and ecological benefits?

The link between capabilities developed from collaborative relationships and actual benefits (e.g. effect on performance) was also not straightforward. Given that few capabilities were found to develop from the relationships, it would seem that benefits appear to accrue mainly through the combination and adaptation of capabilities from each contracting party.

The organisational benefits can be seen as accruing to the OEM, to the service provider or shared between them. The following table (8-3) shows an aggregation of the benefits.

Table 8-3 Main benefits from the product recovery relationships

OEM	Service Provider	Shared
• Low cost compliance (high) • Reduces costs (low to medium) • Improves reputation (low to medium) • Improves flexibility (low to medium) • Increases revenues (low) • Compliance (low) • Re-establish Customer relationship (low)	• Legitimacy for dismantlers - licence to operate (high) • Improves flexibility (medium) • Increases revenues (medium) • Reduces cost ((low medium) • More efficient process (medium to not achieved)	• Compliance (low) • Increases revenues (medium) • Reduces risk and uncertainty (medium)

The research question posits "how do the identified capabilities lead to the benefits?" In order to discuss this causal relationship between capabilities and benefits it is important to return to the actual cases and how each capability is linked to providing specific benefits. This provides the basis for a model linking capabilities to benefits based on the mechanisms found in each case. There were three examples of capabilities developing out of the relationships and these are described next.

The developed capability for control and coordination of the supply chain between Michelin and Sapphire was intended to reduce the uncertainty in returned product, and therefore provide a more efficient process of supplying tyres into cement kilns. In fact this reduction in uncertainty did not materialise as Michelin's ability to influence the supply chain, e.g. retailers, did not perform as expected. Hence inventory levels held by Lafarge and Sapphire were perceived as high and held to cope with uncertain demands (from the cement kilns) and supply (from the tyre retailers).

Xerox and Covertronic worked together to develop new measures and technology to improve recycling levels. This led to the closed loop system which in turn increased recycling levels. The net benefit appeared to be marginal in that the cost of processing the plastic against the price paid by Xerox for the recycled ABS were evenly matched. Revenues from dismantled machines did provide significant benefits for both parties and was based on the efficient dismantling process co-developed between Xerox and Covertronic. This could have only been developed through the collaborative nature of the relationship itself.

By utilising input from GME through their capabilities in marketing and influence over legislation, Autogreen was able to develop a compliance scheme that meets regulation at no cost to the OEM (at present) and was able to gain legitimacy to potentially gain more customers in the future. The influence of GME did not affect the core processes of dismantling business at Autogreen, remaining largely unaffected by the relationship with GME. However, by combining the capabilities of GME and the know-how of the product recovery business at Autogreen, the collaborators view that benefits accrue from the working relationship itself, ensuring that the process fits their requirements and provides maximum benefits (even other OEMs are also joining the process).

Most research into the relationship between 'green'/'ecological' strategies or capabilities and firm performance have tended to use high level measures of performance such as ROA, revenues and the like (Christmann 2000; Hart and Ahuja 1996; Klassen and McLaughlin 1996; Klassen and Vachon 2003; Sharma and Vredenburg 1998). It is believed that no studies have explicitly sought to link product stewardship capabilities (or strategies) and firm performance. Hence this research provides an initial contribution to the field by linking product stewardship activities to actual organisational benefits (and thus performance). A refocus of performance in terms of benefits allows a first view of how these capabilities could improve performance and could form the basis for measuring the impacts of capabilities for product recovery on firm performance. The following figure shows how the developed capabilities from the relationships led to specific types of benefit with different capabilities contributing similar benefits in some cases.

Developed capability from collaborative relationship	→	Benefit
1) Control and coordination of the supply chain	→	Reduce risk and uncertainty
	→	More efficient process
2) New measures and technologies	→	More efficient process
	→	Increase in revenue
	→	Reduced cost
3) Influence legislation	→	Build legitimacy
	→	Reduce risk and uncertainty

Figure 8-4 Linking developed capabilities to specific benefits

8.4 Revisiting the conceptual framework

The following section re-formulates the conceptual framework (as presented in Chapter four) based on the discussion of the cases in this study and discusses a revised version accounting for the findings of this study. The conceptual framework links together concepts related to the external environment of firms such as legitimacy and competitiveness pressures which are the primary source of motivation for setting up product recovery processes (and product stewardship in general). The decision to collaborate with another firm (or group of firms) to provide product recovery processes relates to internal pressures (within the firm boundaries shown on the conceptual framework), but also external pressure: coercive, normative and mimetic in nature. In this study the primary predictors of collaboration concepts were industry level asset specificity and uncertainty. The role of collaboration is predicted, in the framework, to relate to the internal resources and capabilities of the firms involved in the relationship, and specifically a subset related to product stewardship and this research adds to the specification of these capabilities. While the framework suggests a link between the internal resources and capabilities for product stewardship and specific organisational benefits, the framework also shows common ecological benefits which are manifest in the external environment.

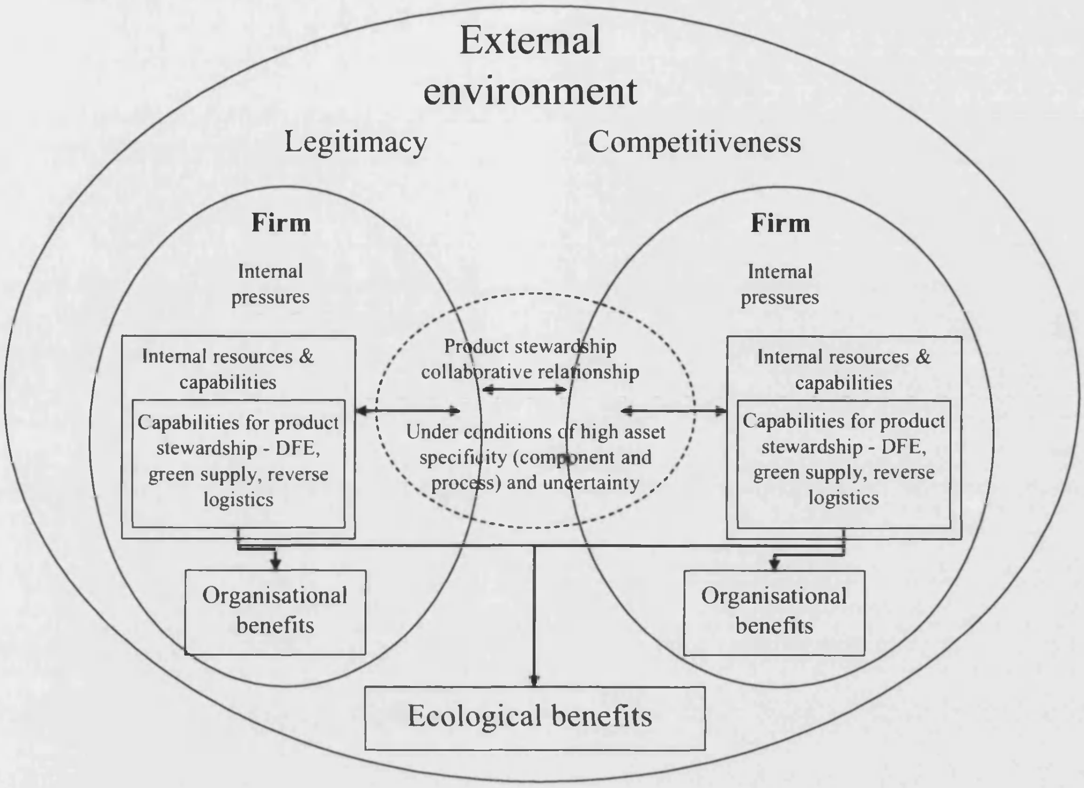

Figure 8-5 Original Conceptual framework for this research (from Chapter four)

Overall the research was supported by the framework by providing a structure to the data collection and analysis. The research did not find major inconsistencies in the framework based on the findings, but minor refinements can be made based on the study. The following figure (Figure 8-6) shows how the conceptual framework has been modified following the empirical research by providing more detail on the conceptual elements of the framework, but maintaining the linkages between the concepts.

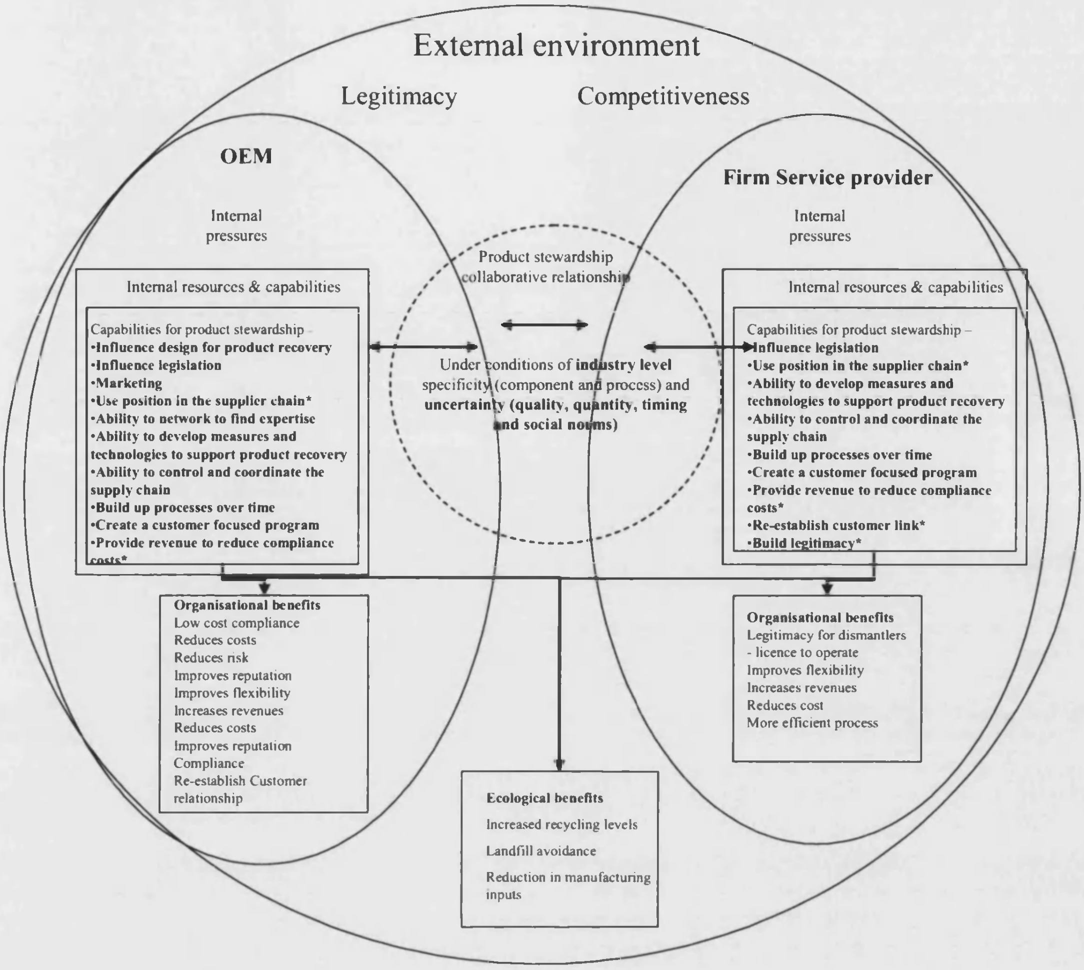

Figure 8-6 Revised conceptual framework

The conceptual framework now incorporates an expanded view of the conditions for the collaborative relationships (i.e. at the level of industry specificity and uncertainty that comprises quality, quantity, timing and social norms) as well as a set of capabilities specific to OEMs and service providers. The overall conceptual framework provided an adequate means for explaining the role of collaboration for product recovery. Both the sources of pressure from the external environment (legitimacy and competitiveness) were found to encapsulate the motivations for adopting product recovery in general and setting up collaborative relationships specifically. The actual collaborative relationships were found to be derived from both specificity of assets as well as uncertainty. However, the research provided a refocus of these concepts for this case, leading to the explanation that collaborative relationships are set up under conditions of industry level specificity and uncertainty due to the return of end of life products (their quantity, quality and timing) as well as uncertainty over the development of external pressures (i.e. legislation). Examining the six relationships in the study showed that the OEM firms and service providers had distinctly different capabilities. Hence the framework is revised with a specified set of capabilities required for product recovery, which differ depending on the role of the firm (manufacturer/producer or service provider). Furthermore the revision of the organisational benefits concept show different sets of benefits across the two parties to a relationship, as well as some that are shared (mutual benefits). The framework now also includes a specified set of ecological benefits that accrue to the external environment to the firms.

8.5 Conceptual framework to conceptual model

The thesis has been informed by two main theoretical perspectives in order to provide an integrative and explanatory framework to discuss the role of collaboration in end of life product recovery. These views span Resource-Based and Institutionalist contributions to theory. These views provide an explanation for one of the significant findings of this research that benefits of collaboration can be in terms of general legitimacy often at industry level (an industry level benefit), but also at the individual firm and relationship levels. Returning to these perspectives provides the opportunity to further explain why these differences occur and add to the theoretical contribution by developing a model linking collaborative relationships to capabilities and benefits.

8.5.1 Resource-based perspectives

The Resource-based View (and natural RBV) of the firm has been the foundation of many studies examining the ecological responses of firms (Christmann 2000; Hart and Ahuja 1996; Russo and Fouts 1997; Russo and Harrison 2005). While this research is no exception, the decision to collaborate in order to gain access to certain capabilities that are required to respond provides a novel contribution to this field of study. The capabilities are based on difficult to transfer resources including investments in tacit knowledge (efficient ways of dismantling products) and socially complex processes (effective networking with materials markets to provide revenues).

The RBV is a theory of competitive advantage and as such attempts to predict when one set of capabilities and associated resources will lead to greater comparative benefits. It is the identification and utilisation of capabilities that are valuable, rare, inimitable, non-substitutable as well as socially complex that forms the basis of sustainable competitive advantage (Barney 1991; Teece et al. 1997; Wernerfelt 1984). Previous research has sought to link this theory of competitive advantage with environmental responsiveness such as pollution prevention or green supply strategies, yet the link between RBV and product stewardship has only been theoretical to date (Hart 1995). While two significant studies have linked environmental responsiveness through pollution prevention and green supply and associated capabilities (Bowen et al. 2001b; Sharma and Vredenburg 1998), this is the first attempt to empirically link responsiveness through product stewardship, end of life product recovery in particular, and the development of capabilities that could yield benefits to firms. Furthermore, there are no empirical studies, that this author is aware of, that have attempted to understand this link in the frame of collaboration between firms, with the exception of Klassen and Vachon (2003) who did not attempt to link collaboration to capabilities. Linking the identified capabilities to existing formulations reveals some similarities between capabilities for product recovery and those which arise from pollution prevention (such as stakeholder integration, continuous higher order learning and continuous innovation as well as those for green supply and logistics in general – see table 8-3). The competitive value however, can only be appreciated within the context of the benefits that accrue to firms. This study isolated capabilities that are associated with EOL product recovery and how these are associated with specific outcomes such as increased revenues, low cost compliance and reduction in risk and uncertainty. Yet it should be noted that a common criticism of RBV is equifinality (Priem and Butler 2001a), which means that multiple firm resources could lead to the same outcome. This research attempts to avoid this problem by only focussing on EOL recovery capabilities and their specific benefits, but it should be noted that overall competitive advantage of these firms may be due to other capabilities in addition, by a greater or lesser degree. RBV also suffers from criticisms of tautology (Priem and Butler 2001b), whereby competitively valuable resources lead to competitive advantage and vice versa, while this is nominally the case in this study, the 'unpacking' of the process sheds more light than some studies that have essentially viewed firms as a black box (Klassen and McLaughlin 1996 for example). Furthermore, the role of collaboration in providing resources and hence benefits to firms has been a recent development in the RBV of the firm (For example Das and Teng 2000; Dyer and Singh 1998; Lavie 2006b). Although applied to strategic alliances this previous work is useful in explaining how the alignment of capabilities through similarity and utilisation, and importantly, identified that the expectations for certain capabilities does not always lead to the expected outcome (confirmed by the tyre case in this research).

An important contribution of this work is to the problem of firm and relationship heterogeneity. The use of valuable resources that are non-transferable (invisible assets) is commonly thought of as the source of this heterogeneity (assuming external influences are equal). Hart's (1995) position that certain capabilities were important for product stewardship is only partially supported by this research. While DFE provides some benefits, especially in the Xerox case whereby more efficient sorting and dismantling is possible, the focus of this research was more on the role of collaboration in providing capabilities. Hart (1995) proposed that stakeholder integration, including integration of business partners, would be important and this research provides a description of how this occurs. However, a limitation of Hart's proposition is that benefits may be equally shared across firms in an industry depending on how and which stakeholders are integrated. Therefore, while firms claim benefits from their compliance approach i.e. low cost compliance, these benefits are equal to those of other OEMs that share the same legitimacy response i.e. those firms contracting with Autogreen for example. This challenges Hart's (1995) view that legitimacy provides competitive advantage through the utilisation of stakeholder integration capabilities.

8.5.2 Institutionalist perspectives

The basis for institutional theory is the ability to show that the pressure to conform (to social norms) can result in inexplicable and inefficient organisational actions and structures. Pressure to conform to these norms include coercive pressures (such as legislation), normative pressures such as professionalisation and mimetic pressures to reduce uncertainty (Martinez and Dacin 1999). The basis for institutional theory is that institutions are sets of rules accepted by broader society, which then take on a structure within organisations that determine the way firms should function (DiMaggio & Powell, 1983; Zucker, 1988). Without doubt, product stewardship actions analysed in this study are partially driven by the above mentioned coercive pressures – legislation in the form of the WEEE Directive and ELV Directives. Not only this, the OEMs studied in this research also show examples of how firms' organisational structures reflect structures in the external environment through the formation of environment department, where personnel responsible for regulatory compliance to producer responsibility pressures reside. Organisational policies also reflect norms in the external environment, whereby product recovery aspirations are commonly integrated into organisational policies in order to internalise social norms and maintain legitimacy (as shown in all the case study firm environmental policies and reports).

The case studies exhibit a number of responses that are key to explaining why firms often do not follow purely economic efficiency arguments (critical to the resource based perspective) which include direct pressure to conform and less direct pressure through mimetic isomorphism whereby firms copy actions of other firms in the same industry to avoid taking risky actions or when the outcomes of certain actions are ambiguous (Bansal 2005; Martinez and Dacin 1999). Hence the responses taken by the OEMs to contract or form joint ventures indicates that the relationships that are set up follow pre-defined frameworks of how product recovery 'should' be organised. For examples, Michelin responded by setting up a JV because that is what they had done in other countries and the development of common vehicle dismantler networks for automotive recycling.

In the product recovery processes studied here where the main driver is legitimacy (the need to comply with social norms such as legislation), firms that choose to respond by contracting with other firms marketed as a 'compliance solution' will find it difficult to achieve heterogeneity in their response, even if collaboration leads to specific exchanges. The research shows that contracting to gain access to capabilities, that are based on industry level investments, limits the responses firms can make. Hence, the universal approach to the EOL process is likely to lead to isomorphic responses, a phenomena grounded in institutional theory. While Oliver (1997) uses this theory in combination to the RBV to explain competitive advantage through both resource and institutional capital, not complying to new regulations on product recycling is not viewed as an option for the firms studied. With the particular view of interfirm level of analysis, which is the focus of this thesis, Oliver (1997) postulates that market imperfections lead to heterogeneous responses as well as differential norms. Advantage can be gained when differential rules and standards are applied to firms in the same industry. This research highlights that the reverse is supported and that the rules behind product recycling lead to isomorphic responses. Furthermore, mimetic isomorphism tends to occur in certain industries e.g. automobiles, leading to universalistic approaches (through links with stakeholders such as trade bodies), eroding any chance of advantage for individual firms.

The Institutionalist view that opportunism is often controlled by the 'social system of norms' also implies that firms may be more likely to leave certain actions to the market and not to integrate, even when specific assets and uncertainty exist (Granovetter 1985). Specifically, the influence of social norms in selecting out opportunistic firms makes leaving activities to the market less hazardous, and thereby making a market response (especially if collaborative, to control for some aspects of uncertainty) more likely. This idea is supported by this thesis whereby specific assets and high uncertainty, still result in a non-integrated activity (Xerox's product recovery process outsourced to Flextronics). For example, in the case of automobile recycling, the establishment of recycling networks (albeit mandated) has led to the de-selection of dismantlers known to act opportunistically and even illegally. Furthermore, this view suggests that industry groups tend to develop common actions to institutional problems, responses that avoid risk but also avoid heterogeneity.

Arguably the automotive industry would have adopted end of life product recovery without coercive pressure from governments, as voluntary agreement were already in place. This could have allowed responses to evolve differently in each country. However individual firm advantages may still have been limited as the voluntary approach (ACORD Agreement) in the automotive sector was based on a trade body level of engagement and consensus building through the CARE industry group. Therefore it cannot be stated that a homogeneous approach to end of life product recovery is only the result of coercive legislation, but is also a result of ambiguity over the 'right' approach e.g. Michelin's pre-emptive actions to start a joint venture.

This section has revisited the key theoretical perspectives that inform this research and attempts to demonstrate that there are arguments for integrating these views when explaining phenomena such as collaboration and product recovery processes. As adroitly stated by Martinez and Dacin, integrating disparate theoretical perspectives is not a straight-forward task but can yield insights if handled carefully. Each perspective has its own short-comings as previously reported, yet utility can be gained through combining theoretical lenses as other researchers have recently done (Bansal 2005; Das and Teng 2000; Madhok and Tallman 1998; Mahoney 2001; Martinez and Dacin 1999; Oliver 1997). While this research does not aim to provide a universalistic and exhaustive integrating framework of two research streams (RBV and Institutionalism), it has provided a context within which a combination of views can be explored. The following section provides an initial approach to understanding the role of collaboration, from multiple theoretical perspectives, within the domain of product recovery processes

8.6 Developing a conceptual model

Theory development is concerned with the relationships between constructs (and their constituent variables and as such in order to truly bring together the two views used in this discussion it is useful to develop a model that encapsulates these relationships in constructs (Bacharach 1989). In adopting the style of empirical case studies, this research builds on existing theory using data to form theoretical linkages between the key concepts, as suggested by Wacker (1998).

The following model attempts to provide a predictive model in order to show when firms that collaborate on product recovery develop competitively valuable capabilities leading to outcomes that are organisationally significant (in terms of benefits) and reduce ecological impacts in parallel. A contribution can be made to existing models of both product recovery and collaboration by integrating views from the literature (spanning a number of perspectives) and the findings from this research.

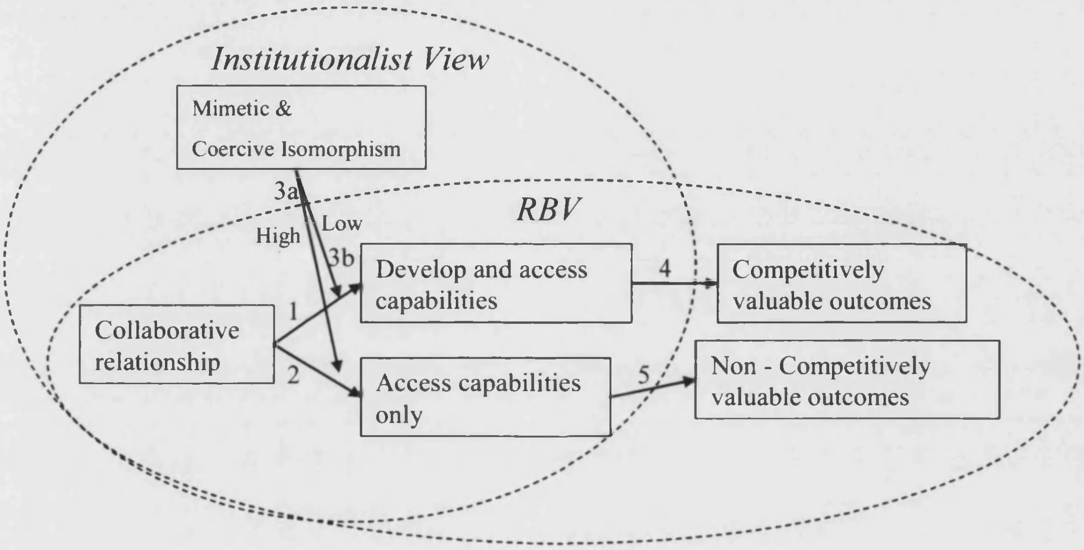

Figure 8-7 Conceptual model of the role of collaboration in product recovery

The conceptual model developed from the analysis of the research findings can be explained using the linkages between the concepts in the model. In figure 8-7 the linkages have been numbered to aid the discussion of the model, and is followed in the next section.

(1) Collaborative relationships for product recovery are predicted to lead to the development of, as well as access to, capabilities when mimetic and coercive isomorphism (3a) is low. These types of isomorphism are low when there are no specific rules and standards set at an industry level, or no specific examples within an industry that the focal firms view as a 'to be followed' model. The collaborative relationship leads to the development of capabilities because idiosyncratic investments can be made at the relationship level that are difficult to transfer in typical market

transactions. These investments include technology and skills in treatment, depollution and dismantling, that are specific to the relationship. These investments on both sides of the relationship are possible because the relationship is not mandated and the OEM has choice in the approach to maximise advantage and hence has a greater incentive to invest time and resource in the relationship itself.

(2) The model also predicts that when mimetic and coercive isomorphism is high (3b), the relationship, while still showing characteristics of collaboration (such as long time scales and high levels of information sharing), is associated with lower levels of relationship specific investments. Thus neither the OEM nor the service provider is inclined to jointly develop capabilities. Instead the collaborative relationship facilitates access to capabilities that serve the needs of legitimacy through compliance to regulations i.e. the service provider has pre-existing investments that allow compliance such as a depollution process.

(4) Competitively valuable outcomes (i.e. benefits) from the relationship are only possible when relationship specific investments have been made. In turn these investments lead to the development of capabilities within the relationship, that cannot be readily shared within the industry group (i.e. that are not easily transferable in the market mechanism). These benefits accruing from the capabilities include the reduction of uncertainty (demand and supply, legislative developments and the behaviour of contractors) as well as increases in revenue, cost reduction, improved efficiency and building of legitimacy.

(5) When capabilities are accessed through collaborative relationships, under the conditions of isomorphism (either mimetic, coercive or both), the investments have already been made by the collaborating parties. These investments are intended to serve the industry as a whole, through a pre-defined set of conditions (i.e. regulations and / or an accepted set of standards) and can be transferred to any OEMs products or processes. Therefore benefits are seen at an industry level and not competitively valuable to individual firms competing within an industry.

The model predicts that OEMs and service providers can maintain a collaborative relationship and yet still not gain competitively valuable advantages, due to the non-specificity of the capabilities and their associated investments. These benefits that are not shared in an industry group will therefore depend on the development of capabilities that are idiosyncratic to the relationship itself and form through the combination of technologies and knowledge of the collaborating parties.

In its current form the model does not predict which capabilities will lead to specific outcomes. While a large scale factor analysis is more likely to yield generaliseable predictions over which capabilities link to specific outcomes. The strength of this research is the unpacking of the process of how collaborative relationships lead to accessing or developing specific capabilities. The mechanism by which certain capabilities lead to organisational benefits is explained, with examples of where they do not lead to expected outcomes when they are not performing. Current gaps in knowledge exist in the literature about how firms work with channel partners to reduce uncertainty in the reverse supply chain and these results specifically address this issue (Prahinski and Kocabaşoglu 2006). For example the development of a capability for control and coordination of the supply chain leads to the reduction of risk and uncertainty in supply and demand of recovered end of life products. In addition the capability to influence legislation also reduces uncertainty in the legislative environment. This research also finds that other capabilities are developed between collaborating partners, that lead to valuable outcomes with the capability to develop new measures and technologies leading to more efficient processes, increased revenue and reduced costs.

It was not expected that so few capabilities would actually be developed within the collaborative relationships studied, as reflected in the 3rd and 4th research questions and so the actual findings refocused the link between the relationships and capabilities to one of gaining access to capabilities at service providers and rarely actually developing capabilities for mutual advantage.

While the research is limited to end of life product recovery, a subset of product stewardship, the conceptual framework and constructs presented in the conceptual model are defined from a higher theoretical level and it is argued that the model could equally be applied to product stewardship in general. Furthermore, it may also be possible to apply the model to collaborative relationships in any field where legitimacy is a priority for firms, such as areas where safety or other social concerns are reflected in industry level responses, government mandates and company policies.

A set of hypotheses and supporting measures are needed to operationalise the propositions and this research provides an initial basis for developing measures that could be utilised in the field. The detailed description of the capabilities for product recovery and the outcomes in terms of organisational and ecological benefits in the findings chapter would give a strong basis for developing measures to test the concepts used in the conceptual model. Concepts that have not been specifically included in the earlier conceptual framework (e.g. isomorphism) have been integrated into the model and literature bases exist to allow the development of measures for these concepts (i.e. Institutional pressures such as coercive, normative and mimetic forces).

8.7 Summary of the discussion

This discussion returns to the original research that was developed from existing literature on collaboration and product stewardship. The actual study focused theoretically and methodologically on a subset of product stewardship: end of life product recovery, covering the acquisition and treatment of end of life products with the aim of avoiding disposal in landfill. The research has answered the research question by providing responses to a number of research sub-questions that were operationalised in the study through a series of three replicated case studies consisting of two OEM-service provider relationships each. Further theory development was proposed through the presentation of a conceptual model linking the key concepts of the thesis.

Regarding the main research question of this thesis:

> *How do collaborative relationships between firms, formed due to ecological pressures for producer responsibility in end-of-life product stewardship, provide capabilities that lead to organisational and ecological benefits?*

This high level question is answered in the critical discussion of the research sub questions. Overall, in these cases capabilities are accessed through collaborative relationships and rarely developed as a result of the relationships themselves. The capabilities that have been identified in this study lead to organisational benefits such as legitimacy and other financially important benefits such as low cost compliance. Where access to capabilities is shared across an industrial group the competitive value of these benefits must be questioned, at least at the firm and relationship level. The capabilities are specifically set up to provide ecological benefits such as a reduction in landfill waste, and in these cases often exceed mandated and expected regulatory targets, although this is not always the case.

The research found that collaboration, as defined as "*the process by which partners adopt a high level of purposeful cooperation to maintain a trading relationship over time*" (Spekman 1989), is indeed common for product recovery operations, with the long term nature, information and knowledge exchange in order to achieve mutually agreed goals being key characteristics. In particular, OEMs collaborate with service providers who already maintain expertise or have the potential to develop capabilities for product recovery. The research identified key capabilities required for implementing end of life product recovery and found that across the six cases, OEMs obtained access to these capabilities through the collaborative relationships. The development of capabilities is less common than the access to existing capabilities and, when it does occur, is linked to lower external environment constraints on responses. This issue implied a re-think of the conceptual framework with relation to the effect of the external environment on firms. Not only was the external environment a source of drivers (legitimacy due to legislation, competitiveness pressure to differentiate or reduce costs), but also constrained the responses that could be made by firms. The ability to obtain competitively valuable outcomes from the collaborative relationships depends partially on the utilisation of capabilities and who has access to these capabilities. The cases demonstrated examples where capabilities simply were not performing as expected leading to suboptimal outcomes (greater inventory levels and operational risk). Furthermore, even if the capabilities were performing the fact that all industry firms in a sector had equal access to these capabilities means that competitive advantage can be ruled out, questioning the applicability of the n-RBV to this context.

This chapter returned to the previous schools of thought that have informed this study and assessed the contribution of each to explaining the role of collaboration for product recovery. The RBV is the mainstay of strategic management thinking on competitiveness and provides a suitable explanatory lens for collaborative relationships for end of life product recovery. Specifically the RBV views market frictions, as seen in collaborative relationships, as opportunities to differentiate with competitors and gain advantage. Yet, this view is limited in explanatory value for this empirical research whereby heterogeneous assets are, in fact, rare. The reason for this paucity of firm or relationship specific assets, hence competitively valuable resources, can be linked to institutional explanations of isomorphism. The recent trend in recent years integrating schools of thought in management is reflected in this discussion where an adequate explanation of the role of collaboration for product recovery is only possible when multiple theoretical perspectives are utilised. In fact, other criticisms of the RBV could be explored here whereby although firm's may gain advantage from non-imitable, non-transferable and non-substitutable resources, the evolutionary view relies on resources that can be transferred and this point is returned to in the conclusion (Mathews 2003).

Hence, the development of a conceptual model attempted to integrate theoretical perspectives on product recovery, by predicting how the collaborative relationships will lead to certain outcomes. The model contributes to both explaining empirically grounded phenomena as well as an approach to integrating theoretical explanations. RBV, as applied to interfirm relationships, is fundamentally centred around efficiency motives (Lavie 2006b; Madhok and Tallman 1998; Martinez and Dacin 1999; McEvily and Marcus 2005), yet this research attempts to link the often competing pressures for legitimacy and competitiveness in an integrative manner taking direction from authors such as Oliver (1997) and Bansal (2005).

The research highlights that a firm's aim is not always to gain competitive advantage – highlighted by one interviewee,*"this is not a competitive issue" (Chief Engineer, Vehicle Manufacturer)* - which limits the usefulness of Hart's (1995) natural-resource based view. Compliance at the lowest cost is a justifiable reason for undertaking product recovery. If there are opportunities to reduce costs more than competitors or even gain revenue, then this is in addition to the main objectives. Thus capabilities for product stewardship have to be seen in the context of whether firms can choose actions that best serve their competitive priorities or are constrained by the set of social norms. Collaborative relationships provide a number of benefits to both OEMs and service providers, including, significantly the reduction in uncertainty in its various forms providing a called for bridge in knowledge in reverse supply chains and the application of forward supply chain thinking (Corbett and Savaskan 2003; Prahinski and Kocabasoglu 2006). Furthermore, the research also revealed product recovery as a customer service and in this case gaining advantage through higher service levels is a prime motivation. For collaboration to provide the means for these aims to be met requires an integrative understanding of contributory factors and limiting conditions, that can only be truly understood by combining theoretical lenses.

Chapter 9 Conclusions and Reflections

9.1 Introduction

This study has drawn on two main literature themes: collaborative relationships and product stewardship. Current debates in these literatures are tackled by directing the research through a series of research questions. In the area of collaborative relationships the research specifically addresses two issues: the resource based or relational view of collaboration and competitive advantage, and role of collaborative relationships in dealing with uncertainty (Dyer and Singh 1998; Lavie 2006b; Zaheer and Bell 2005). While these debates are widely covered in the management literature, this research provides some insights into where the relational view might be a limited perspective and the important role of collaboration in countering uncertainty of various types. Furthermore, the research also draws on the important and growing stream of research into corporate sustainable development, environmental responsiveness and product stewardship (Bansal 2005; Carter and Ellram 1998; Dutton 1998; Hart 1995; Prahinski and Kocabasoglu 2006). Again through the research questions developed from this literature base the thesis tackles three areas of current discussion: the role of relationships for product stewardship; capabilities for product stewardship and the link between product stewardship and firm performance. The following two sections return to the main literature streams that have informed this study and situate the findings within the broader academic debate.

9.2 Collaborative relationships

The management literature of collaborative relationships is drawn from a wide range of sources based in areas including economics, strategic management, operations management and industrial marketing. Simply using traditional perspectives to explain the occurrence and outcomes of collaborative relationships is limited. This research shows that aspects of collaboration can be mandated through regulation and constrained through normative pressure built upon causal ambiguity, as well as due to efficiency arguments over the rational boundary of the firm and core competencies. Furthermore, supporting other research, relationships do not always perform as expected, with failures not being unusual (Lambert et al. 1999).

Much of the activity corresponding to collaborative relationships is seen as the management of uncertainty, with relation to the business environment, technological change, as well the typical supply chain focus on demand and supply uncertainty (Cousins 2002). In this context firms can neither integrate certain activities nor leave these required inputs to traditional market transactions. Recent theories of competitive advantage also see a role for collaborative relationships in the development of capabilities, a process that is fundamental to the contribution of relationships to competitiveness (Dyer and Singh 1998; Lavie 2006b).

To re-state one of the limitations of this thesis, the focus of the study was on collaborations between firms in a vertical supply chain. Horizontal collaborations between firms - even competitors - also exist, as do collaborations with other types of organisation such as public bodies. While the findings primarily relate to vertical relationships between firms, some of the findings may also be applicable to other types of collaboration.

9.2.1 Capability building and the relational view

Referring back to previous research on collaborative relationships, the examples in this study correspond well with Goffin's (2006) recent characterisation of close relationships. The role of relationships in accessing and developing new capabilities also relate partly to the Jacobides and Winter (2005) view that when the capabilities are dependent on firm specific assets they result in integration (for example the Xerox case). Yet the role of collaborative relationships for end of life product recovery appears to be less dependent on notions of reducing risk from contractual hazards, such as opportunism, and more on gaining benefits from capability access and development. To an extent OEMs have little strategic interest in integrating product recovery capabilities unless there is a direct effect on their competitive strategy (gaining new markets for example with remanufactured products), and thus contracting to meet regulated norms is the preferred approach (e.g. GME with Autogreen or Michelin with Lafarge). Instead, OEMs of this study are intent on meeting legitimacy goals through a least cost approach and are thereby focussed on accessing and developing capabilities that support that aim. Hence, OEMs require collaborative relationships to ensure that service providers can help them meet that aim (through sharing of information and knowledge about product designs and distribution networks), and it is the combination of capabilities that allows the meeting of these goals. This combinatorial approach is a cornerstone of the relational view, where contracting parties combine resources that are specific to the relationship to gain competitive advantage (Dyer and Singh 1998). Therefore it is the combination of existing and the development of idiosyncratic capabilities that allows firms to benefit more than their competitors. The development of idiosyncratic capabilities that are tied to a specific relationship appears as a less common occurrence than simply access to capabilities of partners. The analysis suggests that these developed capabilities are linked to conditions of specific investments in an OEMs products or processes and not where the investment could serve multiple partners. The main example in this research is the development of a closed loop recycling system by Xerox and Covertronic, characterised by a site specificity (co-located with Xerox), as well as a process only suited Xerox's product range.

It should be mentioned at this point that for the most part the development of capabilities through the collaborative relationships was viewed a positive outcome by all the parties, although at the same time recognising the limitations of such an approach. Returning to one of the potential downsides of collaboration - restricted technological choice (Jap 2001) - highlights one of the findings that the capabilities developed here may not suit future applications. In the case of Michelin and Lafarge, the issue that burning of tyres in cement kilns is increasingly viewed as not sustainable (at least by some stakeholders), places a risk from Michelin's commitment to that technological approach. Being tied to a joint venture, also ties the partner to a particular approach which should be viewed with caution.

In general the Resource-Based View is an established theoretical perspective that has been adopted by many researchers in the disciplines of strategy, supply chain management and operations management. These studies have provided important contributions to how firms should configure their resources in order to gain maximum rent generating potential (given the right market conditions). Yet this narrow focus on firm advantage has been challenged on a number of quarters. As Mathews (2003) argues benefits also can be at an industry level (drawing on the evolutionary view of the firm), so that shared capability development, or least the development of capabilities that can be of equal access to other industry players is not necessarily in opposition to competitive positioning at an industry level. Thus taking this 'extended resource-based view' implies that capabilities that are not idiosyncratic and can easily be transferred to other firms in an industry could actually benefit the competitiveness of an industry overall. Managers that view product recovery as 'non-competitive' may support this concept of industry level competitiveness at least at a regional level (perhaps where regions compete against regions – Europe and the Far East as examples).

While this research focused on collaboration in a vertical supply chain, there may also be merit in applying the conceptual framework to other types of collaborations for example between competitors. The findings suggest that if the right capabilities are combined within a collaborative relationship with significant information and knowledge sharing, and agreement on mutual goals, then developed capabilities may provide benefits that are competitively valuable within product stewardship. These findings are sufficiently generic to imply that this process could be adopted within competitor relationships (such a strategic alliances). On the negative side, assuming the relationship does not lead to at least industry specific investments, under conditions of uncertainty, then the value of the benefits may not be significantly higher, compared to where collaboration does not occur. This application of the model is returned to in the section on further research.

A further point of discussion relating to capability building and collaboration links back to earlier discussions of product stewardship in the supply of materials to product manufacturers. Collaborative relationships based on typical goods and service exchanges can also be developed to incorporate aspects of product stewardship as is often the case in green supply (Bowen et al 2001; Pujari et al 2003). Although the cases here did not explore examples of existing relationships and how these could be modified to support product stewardship objectives, some examples of potential developments were found. In particular the case of GME and Autogreen showed evidence that the relationship could be developed further to include new area of collaboration, for example in developing a 'green' line of used parts, branded under GM. These were just ideas, but show the potential for existing relationships to be developed further in support of product stewardship.

9.2.2 *Managing uncertainty: a role for collaborative relationships*

The role of uncertainty in predicting collaboration (between markets and hierarchies), in the presence of at least industry-specific assets, is an important addition to the literature. This research provides evidence that the role of collaboration is in accessing and developing capabilities when there is uncertainty over response to, and future developments in, the business environment (including technology and demand and supply). The response to uncertainty is central to institutional theory, which historically, has strongly drawn on the work of Simon (1957; 1979) and March (1958; 1988). Uncertainty in the business environment has been used as a factor to determine the closeness of relationships by many authors (Carter and Ellram 1998; Contractor and Lorange 1988; Cousins 2002; Cousins et al. 2004; Goffin et al. 2006; Williamson 1975), and this research extends this by showing the mechanism by which firms can leverage their relationships to both reduce uncertainty (improve the predictability of the business environment) itself and to reduce the impacts of uncertainty (reduce risks).

In addition to this, institutional effects have not been central to debates over collaborative relationships with Martinez and Dacin (1999) making specific mention of the impact of institutional fields on the ways firms build relationships. As aptly put by Selznick (1992: 232) "*institutionalization constrains conduct in two main ways: by bringing it within a normative order, and by making it hostage to its own history*". This research shows examples of these two processes for example that the level of information sharing can be legislated thus mandating flows between firms (for example demand, supply, performance such as recycling levels and design information). Also collaborative relationships (the Michelin Lafarge JV is a case in point) can have an historical precedent in the originator firm, or where the view of the 'industry' through the trade associations and working groups is to work collaboratively (a normative prescription). Therefore collaborative relationships in both the Michelin and GME cases could be viewed as driven from institutional processes reacting to the ambiguity of efficiency arguments as well as the direct coercive effects of legislators. As considered by DiMaggio and Powell (1991: 70), "*The ubiquity of certain kinds of structural arrangements can more likely be credited to the universality of mimetic processes than to any concrete evidence that the adopted models enhance efficiency*". While this perspective has been utilized in the field of supply chain management to a limited extent, for example recently explaining the 'bandwagon' of supply chain integration or the outsourcing of IT in firms (Frohlich and Westbrook 2002; Lacity and Hirschheim

1993), it is a useful viewpoint from which to analyse other interorganisational forms such as collaborative relationships (and especially in the broader domain of sustainability). It is interesting to note that a theoretical perspective drawn from the literature supporting product stewardship has an influence on the interpretation of results of data on collaborative relationships, itself influenced by supply chain management theory.

Collaboration is a well developed construct, but still is ambiguous in that a number of schools of thought have described it in different ways depending on the ontology adopted (the language used to describe it) e.g. a mechanism for reducing transaction costs, providing access to external resources (RBV and Resource dependency) or simply the way contracting is done (institutional). This research supports the view that this is a multi-dimensional construct, and while there are key components such as duration and mutuality, these may not always by aligned. For example where duration is a function of legislated targets (e.g. recycling levels for cars) other components of collaboration may not necessarily follow. Thus collaboration can exist to both act as a safeguard as well as a mutual rent generation process.

9.3 Product stewardship

Product stewardship is not a concept regularly used in the management literature and its origins are more the literatures of engineering and systems. The notable and significant exception is Hart (1995), who firmly situated product stewardship as one of the strategies that firms can adopt to address society's call for more sustainable industries. This research has chosen a sub-set of activities to product stewardship, end of life product recovery, to limit the scope of the study and provide a more focused theoretical standpoint. In doing so it was possible to draw on the rich seam of literature on reverse logistics, within the general theme of supply chain management (Good examples include Carter and Ellram 1998; Dowlatshahi 2000; Guide Jr and Wassenhove 2002; Prahinski and Kocabasoglu 2006; Van Hoek 1999).

9.3.1 Relationships for product recovery

The generic map of relationships (Figure 8-2 p.229) shows that the concept of reprocessors should be redefined to include companies in a symbiotic relationship e.g. outputs from industry are inputs for another industry (in comparison to previous network maps e.g. Fleischmann et al. 2000; Prahinski and Kocabasoglu 2006). Furthermore, this research theme is extended by including the range of relationship types for product recovery (and therefore product stewardship), covering a spectrum from integrated activities to pure market transactions (i.e. where there is no market failure). By taking a strategic view (not purely process engineering approach) this research provides an addition to the product stewardship and reverse supply chain literature, linking established theory to this important domain. Corbett and Savaskan (2003) call for the application of forward supply chain thinking, in the areas of coordination and contracting, to product recovery. In particular the role of collaboration as a means to control or reduce uncertainty is explained, responding to Prahinski et al's (2006) specific call to address this research gap.

9.3.2 *Capabilities and product recovery*

Capabilities have recently been defined as *"a capacity to integrate, combine and deploy tangible and intangible resources through distinctive organizational processes in order to achieve desirable objectives"* (Lavie 2006a: 153). Adopting this definition for this research shows capabilities for product recovery include those identified for PS and logistics in previous studies (Bowen et al. 2001b; Hart 1995; Zhao et al. 2001), plus a number that appear particularly suited to product recovery specifically (see Table 8-2 p.233 for a summary).

This research adds to the growing stream of knowledge in product recovery management, reverse logistics and green supply chain management by defining capabilities that appear important to gaining benefits from product recovery. Some OEMs are able to use their position in the supply chain in order to influence the supply of end of life products from the market (in one case through the exercise of market power). Building on the substantial literature on social capital (Nahapiet and Ghoshal 1998), the ability to network to find expertise by OEMs appears to be a function of their network ties (within trade associations, industry working groups as well as their collaborative relationships with service providers) and allows the identification of suitable partners in the product recovery supply chain. This research also finds that the service providers ability to provide revenue to reduce compliance costs is key to the economics of product recovery (whether through re-use, remanufacturing or recycling) and is built up over time, again through supply chain network ties, but in this case of the service providers (Covertronic, Autogreen, Bridges, Sapphire). These capabilities tend to be pre-existing within the firms and are accessed by the OEMs planning to establish a product recovery process. The research highlights a couple of instances where capabilities (not identified in other research) are developed through the collaborative relationships and these specifically relate to re-establishing the customer link and building legitimacy.

The activities of the OEMs to access and develop new capabilities in response to market (or business environment) changes, could be viewed in terms of dynamic capability (Winter 2003), a meta-capability that has been defined as "*processes to integrate, reconfigure, gain and release resources—to match and even create market change*" (Eisenhardt and Martin 2000: 1107). This type of capability, however, is contingent on the condition that the firms are able to exercise some degrees of freedom in their response. As shown in the case companies of this research such as GME, Michelin and Xerox, firms can be constrained in their response to varying degrees. Although collaborative relationships (and their role in providing social capital for example) may form a facilitator in integrating, reconfiguring and gaining resources, and thus capabilities (Blyler and Coff 2003), the constraints of pre-determined pathways and mandated procedures for product recovery limit the usefulness of this explanation. Given that collaborative relationships do, on occasion, lead to the access to and development of capabilities for product recovery, for these capabilities to be of competitive value they must improve performance in some way. This leads to the question of how product stewardship is linked to performance in general, and how capabilities from collaborative relationships provide benefits from product recovery specifically?

9.3.3 The link between product stewardship and performance

Most research examining product recovery has taken an operations research perspective focussing on the engineering of the reverse supply chain (Fleischmann et al. 2000; Guide Jr et al. 2000; Guide Jr et al. 2003; Klausner and Hendrickson 2000 are good examples of this approach). Little has been written on the strategic dimension, with Guide Jr and Wassenhove 2002; Thierry et al. 1995; Toffel 2003 as the main exceptions. This research situates product recovery at the relationship (strategy) level, centering on literature that has looked at CSR, CSD and product stewardship. This is a suitable level because much of the capability literature is focused within strategic management especially when these issues are an effect of the boundary decisions of firms. In addition, the strategic implications of new regulations would indicate the value of this level of analysis of firms and their relationships. Furthermore, previous studies have resulted in mixed findings over the link between product stewardship-related concepts and performance (Christmann 2000; Klassen and McLaughlin 1996; Klassen

2000; Melnyk et al. 2003; Rao and Holt 2005; Russo and Fouts 1997), and these studies only include some elements of product recovery.

To counter this issue, Gonzalez-Benito and Gonzalez-Benito (2005) call for a disaggregation of environmental proactivity, as a research construct, and to make specific links between specific parts of the 'environmental proactivity' construct such as product recovery, to performance. This research has responded to this call by disaggregating environmental responsiveness into PS and PS into end of life product recovery and shown the specific links to performance (described here as benefits). This is an important point because previous studies have found that linking higher levels of abstraction of environmental responsiveness to performance problematic to operationalise, hence 'breaking down' this concept allows a more precise (and causal) link to be made. The second point is related to the definition of performance. This research specifically views performance in two ways – through competitiveness and legitimacy – while related and treated distinctly (see Table 8-3 p.237 for the identified benefits). Additionally shown the mechanism of achieving performance (through benefits) by including the concept of capabilities (see Figure 8-4 p.238). The research has shown that, although not in all cases, there are examples of how developed capabilities for control and coordination of the supply chain can lead to reduced risk and uncertainty (in supply and demand) as well as a more efficient process (reduced inventory) providing the potential for competitive advantage. On the other-hand some collaborative relationships are instrumental in developing a capability for influencing legislation, so that both business environment uncertainty can be reduced and legitimacy improved through coordinated communications with legislators.

Product stewardship originates from engineering and systems perspectives with concepts such as life cycle analysis, design for environment (or recycling). The product stewardship construct has only recently entered the mainstream of management thinking and analysis, and tends to be decomposed into its constituent parts such as green supply, pollution prevention (with a manufacturing focus). Product recovery itself also originates from engineering and operations research studies and has strong ties to reverse logistics in the operations management field. It could be argued that product stewardship is a response to corporate social responsibility imperatives, and it is here that the link to strategic management thinking is established. This research has applied strategic management thinking to this construct to explain how collaboration plays a role in product recovery. Yet it could also be argued that for many firms product recovery is not a strategic issue (like other ecological concerns). As one automotive OEM manager stated "*I don't think anybody's got much of a competitive strategy*", or another "*within the UK car manufacturers we've treated end of life vehicle and issues of how recyclable is your car as a non-competitive issue..*". One could argue that product recovery is becoming more strategic as legislation further challenges firms' licence to operate. This development may encourage a re-think of the business models employed where product recovery could be integrated into the mainstream business, such as at Xerox. For this to happen, market incentives need to be in place for example a shift to product-service systems (something the EU already considers). In this challenging area where the market offering spans the whole duration of the product lifecycle (both in terms of individual product and the cycle of new products), a commensurately extended arc of integration seems likely (Frohlich and Westbrook 2001). Bringing together resources and capabilities from traditionally distinct areas as well as the continued divestment of 'traditional' functions such as manufacturing would imply a growing role for collaboration, and analysis into collaboration models for the future.

9.4 Combining theoretical viewpoints

In looking at responses that are variously imposed by regulation, and competitive trends, mixing views on diverging pressures appears highly appropriate. Although combining theoretical views in supply chain management and related literature is not a new idea (For examples see Barringer and Harrison 2000; Das and Teng 2000; Madhok and Tallman 1998; Mahoney 2001; Martinez and Dacin 1999), linking resource-based and institutional perspectives is rare in the management literature. Hence for this research both a resource-based view and institutional perspective were taken. The resource-based explanation adopted in this study was founded on Hart's (1995) natural resource-based view of the firm, to explain how firms adopt product stewardship. To account for the relationship perspective of the research, the relational view developed by Dyer and Singh (1998) was utilised to explain how collaborative relationships provide the conditions for developing capabilities and specific benefits to the parties of a relationship. Problems arise in only using the resource-based perspective however, when there is evidence that firms also adopt product stewardship due to coercive or normative pressures, and implement collaborative relationships as a response even though rational efficiency-based arguments are not evident. In accounting for both view-points Oliver (1997: 697-98) criticises the resource-based view in that

"..it has not examined the social context within which resource selection decisions are embedded (e.g. firm traditions, network ties, regulatory pressures) and how this context might affect sustainable firm differences. Nor has the resource-based view addressed the process of resource selection, that is, how firms actually make, and fail to make, rational resource choices in pursuit of economic rents"

Thus the institutional perspective provides theoretical explanation for why this is the case. Furthermore, as emphasised by Bansal (2005) research into organisations and the natural environment requires both resource-based and institutional arguments to explain the actions of firms. Combining views is especially pertinent to the growing research agenda on corporate sustainable development where previous research has a focus on either institutional (Jennings and Zanderbergen 1995; Prakash 1999) or resource-based views (Hart 1995; Klassen and Whybark 1999; Russo and Fouts 1997). By taking up alternative explanations, the shortcoming of either approach can be at least partially circumvented.

While Bansal (2005) and Oliver (1997) provide examples of how this combination of theoretical arguments can be achieved, this research additionally accesses a research domain where this approach can be applied empirically. The research has attempted to build on these theoretical explanations for how 'firm traditions, network ties and regulatory pressures' affect the differences in the cases presented and analysed.

Hence the contribution of this study to the combination of resource-based and institutional arguments is the development of an empirical model (Figure 8-7 p.247), used to predict when firms will develop competitively valuable capabilities through collaborative relationships and when these capabilities will be constrained by institutional effects (such as traditions, ties and regulations). The model opens up the opportunity to undertake further study in the interrelation between competitive advantage and legitimacy, clearly important concerns across many management issues (environment, safety, social equity) and may be one approach to research in the challenging field of sustainability and corporate sustainable development.

9.5 Implications for practice

One of the significant findings of this study is that the capabilities that are accessed may not always perform to provide benefits for product recovery. While firms contract on the basis of complementarity, the perception of managers that a partner's capabilities are applied to new situations should be viewed with caution at the outset. For example, Michelin's influence over ATS, the franchise service outlet, had worked in the past causing ATS to adopt certain retail standards. However, this influence did not always stretch to product recovery, despite the joint venture partners' expectations that this would provide a stable supply of tyres to the service provider Sapphire. Using the argument that 'this is what we have done before' or 'this is our standard model for product recovery' is clearly limited in this case, where the assumption that patterns of influence will be easily transferable from one context to the next.

For OEMs to obtain competitive advantage from product recovery requires some degree of response heterogeneity. While low cost compliance tends to be the primary aim of OEMs, differentiated approaches may provide opportunities for lower costs than competitors. The main obstacle to this is that service providers will often undertake a common process for all products in an industry, the examples include tyres, automobiles and mobile phones in this research. Even where products are designed to be more recyclable than competitor's products, unless the recovery operations are differentiated the benefits of implementing higher levels of 'DFR' cannot be realised, as is the case today. The collaborative relations in the present study do not provide for this heterogeneity and limits the potential for comparative rent generation. Uncertainty over the response to regulation could also provide the source of, at least, temporary advantage. The case of BMW implementing product recovery many years before legislation came into force has been widely reported, suggesting that pre-empting regulation can provide benefits (for example as reported by Hart 1995). Yet within this study there is no specific evidence to support that this is actually the case.

On the service provider side there are clearer benefits of increasing scale and therefore revenues overall. Contracting with large scale MNE with existing reputational 'capital' is also seen as valuable to building legitimacy in a new a growing industry of product recovery especially where professionalism is viewed as low in some areas (e.g. car dismantlers).

In general lessons from across the cases show that it is possible to gain benefits from end of life product recovery the overall strategy can be tied back to a market need. The leasing (product-service) model of Xerox for example allows the producer to select the timing of product retirement and thus enhance the possible value for recovering the product. By employing designs that allow upgrading and remanufacturing to as new levels, plus a relatively fast product life cycle Xerox is able to gain revenue from its product recovery processes while at the same time meeting expected legislative requirements. While this case stands out as a good example of how collaboration can provide specific benefits from certain activities that are not viewed as core to the business (recycling), the specificity of the case itself has to be recognised. In particular both the business model and design of the product facilitate opportunities in product recovery. Simply transferring the systems and processes to other industries is likely to be problematic given differences in product architectures, life cycles, sales and distribution models and customer expectations

9.6 Implications for policy

The DTI have a stated objective to 'not gold plate European legislation' (DTI Officer), which means that they have an aim to ensure European legislation is transposed into UK regulation to meet the minimum requirements but not compromise UK business interests. Despite the fact that industry has set up voluntary codes for product recovery such as ACORD (for cars) and ICER (for electronic products) and Fonebak (for mobile phones), legislators continue to pass legislation to improve the levels of recycling of consumer (and business) waste and ensure systems are in place that facilitate the collection and treatment of this waste . Clearly, voluntary and pre-emptive agreements and codes have not staved off the desire of legislators to impose standards on business, and specifically producers. This clearly signals to businesses that attempting to pre-empt legislation and even dissuade legislators from passing regulation is somewhat futile, as laws will be introduced in any case. Hence how can policy makers improve producer's environmental impacts without implementing costly regulation (costly both to society in general and businesses in particular)?

This research suggests that legislation does not provide suitable background to businesses attempting to make a 'business case' for improved environmental performance but instead reduces the chances of gaining advantage from this new area. A possible solution to this dilemma is through the introduction of flexible regulation and guidance to industries in how regulation can be met while still maintaining a differentiated approach to competitors. This is particularly the case when legislation limits the freedom of market dynamics to provide the lowest cost solution. In fact in the automobile case the setting of new standards and requirements has limited the number of organisations able to provide a 'compliance' solution for producers so that in effect a duopolistic (or if a restricted number of other new entrants start trading then oligopolistic) market has developed with only two suppliers of services (Autogreen and Cartakeback).

9.7 Reflections on the research process and limitations

In this research study I present a series of cases that describe collaboration as a process to enable product recovery. As a process, timescale is an important element. Although my research does not show collaboration as a staged process, each case shows collaboration at a particular point in time. Pressure to adopt product recovery is a recent phenomena experienced by many firms (especially producers) and as such there are few firms with a mature process in place (Xerox is one of very few). My challenge was to find, gain access to and research cases in a very new field in a manner that allowed comparability. Hence the cases chosen reflect these constraints. A particular problem I faced was the delay in legislation being implemented in the UK by the DTI, which risked the complete automobile case. Automotive firms had to delay any contracting until clear direction was given by government. As it was, I was fortunate to have a continued dialogue with managers at GME in charge of ensuring compliance and obtained some interesting insights into how they faced uncertainty in the development of legislation.

The atmosphere (to coin an IMP term) surrounding the relationships during the period of flux such as the introduction of new regulation puts firms such as service providers in a newly competitive situation i.e. opportunity to expand their traditional markets. This caused some initial difficulties in obtaining information that related to contractual conditions for example and the explicit cost implications of different arrangements. This was resolved by discussing relative terms instead of absolute values

As Yin (1981: 31) states,

> *"case studies, like experiments, are generaliseable to theoretical propositions and not to populations or universes. In this sense, the case study, like the experiment, does not represent a 'sample', and the investigator's goal is to expand and generalize theories (analytic generalization) and not to enumerate frequencies (statistical generalization)".*

The research design and specifically the case protocol was employed to provide data on a specific unit of analysis, the relationship process, in a way that compares two relationships between a common firm (an Original Equipment Manufacturer or

Producer) and two service providers. In practice, some flexibility had to be exercised as examples of end of life product recovery influenced by legislation were relatively rare. In fact this gave the opportunity to examine a range of relationship types from joint venture entities to divested operations, which I believe adds strength to the findings.

Table 9-1 Limitations and threats to validity of the study

Concerns	Actions taken	Possible further actions
Construct validity	The terms and definitions from coding were derived from the literature Chain of evidence Review by key respondents Multiple data sources	Utilise, modify and create scales for measurement of constructs
Internal validity	Multiple informants and sources of evidence (site visits, interviews, company documents) Informants checking transcripts and case summaries	More informant checking case summaries, but this is limited due to timescale
External Validity	Multiple respondents within and across companies, in order to counter reflexivity Three industries; 2 dyadic relationships each Pilot study	Include more cases if resources and time allowed
Reliability	A repeatable, structured case study protocol was used	Use firms and industries with the same organisational structures, but difficult achieve across industries
Causation	A process view meant that cause-effect links were discussed with respondents	Explicitly longitudinal studies may provide clearer links to outcomes
Generaliseability	Three industries; 2 dyadic relationships each. Theoretically generaliseable	Larger cross-sectional sample, to test links between concepts to enable statistical generalisations

A classic problem faced in interview based research is reflexivity. This is particularly the case for subjects that are affected by legitimacy, where 'impression management' is a key response to gaining legitimacy. Product recovery is currently highly politicised and the research design attempted to avoid 'staged' performances where possible. Specifically the design allowed multiple perspectives on the concepts presented in the conceptual framework and the research questions that were derived from this, for example gaining responses from both parties of a relationship and also firms not directly involved in the case but part of the industry group (e.g. on the same lobbying panel or industry body such as the SMMT or CARE). Although there were no significantly divergent views in the research questions, this research may have been affected by this type of bias to a limited degree.

A final important reflection on the research process is the use of systematic computer-based qualitative analysis tools such as NVivo. While this allowed the efficient search and coding of data, this tool does not remove the need for interpretation of data and hence is affected by subjectivity. Established concepts (and their definitions) were used extensively in this study in an attempt to avoid individualistic interpretations. However the operationalisation of many of the concepts used still represents a serious challenge to management researchers. I would hope that further research can build on this study by developing variables and measures based on the main concepts used here.

9.8 Reflections on future research

This research has tapped into a rich seam of research topics that will continue to be relevant for many years. These topics justify a rigorous academic debate on appropriate responses to the changes in the firm's external environment. The findings of this research have been disseminated through conference presentations and proceedings, for example at 13th conference of International Purchasing & Supply Education and Research Association and the 2005 International Conference on Design and Manufacture for Sustainable Development and CIRP 2005. There are also plans to develop parts of the thesis into full academic papers, to be submitted to general management journals (such as the Journal of Management Studies) and operations management journals (such as International Journal of Operations and Production Management). However, there is significant scope to develop this research stream further to engage current theoretical debates and to find practical ways of aiding industry to reconcile often conflicting agendas.

While this research employed an explanatory case study approach, deemed suitable from both theoretical (explanatory theory needed) and methodological (limited study population) viewpoints, there is significant opportunity to extend the research into a wider cross-sectional study in the future. In developing a conceptual model, this study extends the current research agenda from a theory building exercise to one of generalisation. The study was based on a primarily abductive logical argument to allow the consideration of existing constructs and variables, while at the same time being open to new definitions grounded in the detailed set of data emerging from the primary research. As such this study also provides an initial set of measures for concepts such as product recovery capabilities and organisational benefits. Transferring these descriptions to testable scales should be possible with some further validation in the field, possibly across a wider set of industry types.

Furthermore, the research was primarily based in the UK, examining the UK context in terms of regulatory pressures. While these pressures originate in Europe it would be interesting to test how countries that have a more historically developed set of product recovery capabilities are influenced by changes in the regulatory environment (and perhaps the general business environment). One would expect, from the results of this research, that for countries that have an established set of capabilities for product recovery, the development of new rules that challenge these capabilities would be met with a certain degree of resistance. This and other contextually dependent hypotheses would benefit from studies that explicitly take a multi-country approach in terms of research population.

A further possibility to extend this research would be to take a more systematic longitudinal approach. It would be useful to follow-up these cases with a longitudinal analysis to allow further details of collaboration as a cyclical process. As a result of resources constraints, the cases took a view of the process over a series of months, but given the timescales of legislated demands and targets, a study that incorporated a timescale of years would shed further light on how experience and knowledge, affects the development of capabilities and also importantly the outcomes. For example the study by Bansal (2005) looking at the effects of corporate sustainable development undertook research over a number of years. A core question would be do the relationships really meet the expectations of firms and wider society in the long run, for example does Lafarge's tyre incineration solution provide a long term answer to the disposal of tyres or will public attitudes change what is viewed as an acceptable disposal route? However, the approach to answering such a question would have to be different to the method taken here, whereby findings have to be comparable over multiple periods of time.

Examining future research by building on areas that have not been included in this study provides a suitable ending to this thesis. The possibility that product stewardship capabilities could be developed from existing relationships is well covered on the inbound side of manufacturing firms. There could be potential in exploring whether this phenomenon exists on the end of life side of the product life cycle. In particular the developing area of networks and the theories behind network thinking has formed the basis of much recent research in the fields of collaboration and environmental strategies.

While the cases here analysed a very specific set of relationship types, the general issue of knowledge transfer and creation within networks of firms would be an important area of future work, especially where the spread of environmental innovations across an industry may be an important determinant of overall ecological performance. There may also be opportunities to extend the application of the conceptual framework developed in this research to other types of relationships to both extend its applicability and explore other types of relationships and their contribution to the increasingly convergent goals of industrial and ecological sustainability. As the opening quote in this thesis states, "*Ecology and economy are becoming ever more interwoven – locally, regionally, nationally, and globally – into a seamless net of causes and effects*" [1].

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APPENDICES

Appendix One Case study protocol

Thank you for agreeing to take part in this research project based at the University of Bath, Innovative Manufacturing Research Centre and funded by the Engineering and Physical Sciences Research Council. Individual case summaries will be delivered to your company in return for your involvement

Stage One

The first stage of this research is designed to capture data on the network structure of firms involved in end-of-life product management. The following questions are intended to guide a mapping process. This process shows the structure of the network, depicted visually on a large sheet of paper with annotated 'post-it' notes.

Prompt questions

1) Who are the 'suppliers' for the end-of-life (EoL) product management process? Please provide details of the extended networks e.g. OEM - consumer/retailer - distributer - dismantler - material reprocessor - demanufacturer.

2) Describe the activities? Re-man, refurb.,recondition, repair, logistics, etc

3) Where are the locations of the facilities - warehouses, depollution sites, dismantling sites, demanufacturing facilities?

   - Identify suppliers and recyclers downstream if not already done so.
   - [Is the map complete - enlist other informants if necessary]

4) Where do other stakeholders fit into this relationship map? (Legislators, Tas, groups)

5) Describe the characteristics of the main relationships between the OEM and other firms in the EoL product management network -

   - Which relationships can be viewed as collaborative? (Reasons for sourcing, attitudes to planning, prices, quality, delivery, R&D)
   - Are any of the activities vertically integrated?

6) Identify sites and personnel (OEM and supplier/contractor) to provide further details on **TWO** of the collaborative relationships identified.

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Stage Two

The second stage of this research is designed to capture data on the collaborative relationships for end-of-life products identified in stage one. This semi-structured interview schedule provides an outline of the questions that this research project is exploring. The interview will be recorded to ensure accuracy. Please advise during the interview if other functions will be able to provide additional responses to some questions (such as purchasing, operations, logistics).

Background

1.1 How do ecological issues impact on your firm and the industry in general?

Prompt: To what extent do the sources include legislation, customers, suppliers, local communities, other stakeholders?

1.2 What are the specific drivers for getting involved in the product's end-of-life?

Prompt: Are there industry specific issues, legislation, industry groups?

Operations

2.1 Describe the activities that your company is responsible for with regard to end-of-life products.

2.2 What are the goals of these activities?

Prompt: Achieving compliance, meeting new voluntary standards, least cost, profit

2.3 Describe the capabilities needed to achieve these goals

Prompt: examples of using specialised assets such as personnel, plant/equipment, expertise, sites

The relationship and associated capabilities

4.1 Describe the relationship that exists between your company and the chosen firms as identified in stage one.

Prompts: use the table to help describe the relationship

Type of competition	Closed, but plenty of business - chaotic - some collaboration
Reason for sourcing decision	Wide, lowest bid - dutch auction - PQD - perf history LT source

Role of data and information	Minimum - 1 way, closed - open book - 2 way transparency
Attitude to capacity planning	Few problems - no system - improving - coordinated jointly
Delivery practices	Large batches - JIT
Attitude to price change	Negotiation - conflict - collab - ann. increase - planned reductions
Attitude to quality	Inspections - aggressive - joint effort - joint planning
R&D	Not involved - joint programme
Pressure on relationship	Low - medium - high - very high
Certainty	Contractual - competence - goodwill - political
Dependence	Historic - economic - technological - political
Relationship specific investment	Sites - personnel - plant equipment
Routines for knowledge sharing	Formal or informal - written rules/procedures - 'learning by doing'
Complementary resources	Joining resources (teams) - cultures (in)compatible
Modes of governance	Bilateral investments - mutual agreement of goals - trust

4.2 Describe the capabilities that each of the two companies brings to the relationship.

Prompt: skills, resources & functional competencies, physical & human assets - ability to provide shared vision and/or trust-based relationships with other external stakeholders

4.8 To what extent can the capabilities be thought of as competitively valuable?

Prompt: Do the capabilities have the following characteristics?

- Takes a long time to develop
- Competitors can not build up these capabilities faster through a greater application of resources
- They provide benefits to several functional areas or departments
- They provide benefits to different levels within the company
- They clearly lack an identified owner (an employee cannot leave with the capability)
- They act as a trigger for collective learning within the company
- They act as a trigger for innovation within the company
- They act as a trigger for collaborative problem solving with stakeholders

They combine with other assets to generate benefits for the company

4.3 What are the organisational benefits of this relationship?

Prompt:

- Cost reduction
- Leadtime reduction

- Improved quality
- Improved market position
- Enhanced reputation
- Design/develop better products
- Reduced production waste
- Reduced waste in equipment selection
- Better opportunities in international markets
- Pre-empt competitors

4.5 What are the ecological benefits of this relationship?

Prompt: do the benefits include reducing the product's impacts by....?

- Meeting new standards (ELV, WEEE, ROHS Directives or others)
- Improving product design
- Improving process design
- Improving disassembly
- Improving substitution, reduction, recycling or rebuilding or remanufacturing
- Prolonging product life
- Improving use of returnable packaging
- Spreading environmental risks
- Creating markets for waste products
- Improving waste segregation
- Improving dialogue and relationships with environmental stakeholders

4.6 Explain how the 'partner's' capabilities help your firm achieve the described benefits?

4.7 To what extent have capabilities developed out of the relationship?

4.9 How have the characteristics of the relationship led to the utilisation or development of the described capabilities?

4.10 How will the capabilities change in the future as a result of the relationship?

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Stage Three

The third stage of this research is designed to capture data from direct observation and secondary sources of firms involved in end-of-life product management. The table provides an outline of the expected observational characteristics of the site to support stage two of this research. The list below details the preferred documentary evidence to support data collected in both stages one and two.

Name and address of site	
Names and position of personnel	
Main site activities	
Evidence of organisational benefits	
Evidence of ecological benefits	
Other site characteristics of relevance	
Photographic / video evidence where possible	

Documentary Evidence

- Company background information - press releases etc
- Company reports
- Contractual agreements
- Correspondence
- Newsletters
- Organisational charts
- Minutes of meetings

Confidentiality can be protected by stamping - **NOT TO BE COPIED** - on all documents

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Appendix Two Sources of data (primary and secondary)

Interview list

	Who	Company	Comments
		Pilot study (Mobile Phones)	
1	Dominic Wing	Shields, Director	April 03
2	Louise Morgan	T-Mobile, Environment Advisor	March 03
3	Jan Mirkowski	T-Mobile, Environment Manager	March 03
4	Kathy Woodward	Shields, MD FoneBak	April 03
		Cars	
1	Mark Morgan	Autologic Marketing Manager	May 03
2	Mark Morgan	Autologic Marketing Manager	May 03
3	Brian Setchell	GM, ELV coordinator	June 03
4	Geoff Bridges	Bridges Managing Director	Nov 03
5	David Chesney	Autologic, ELV Director	Nov 03
6	Chaz Ambrose	Trents Environment Manager	Jan 04
7	David Chesney	Autologic, ELV Director	Jan 04
8	Ian Gaskin	Universal Services, Operations	Mar 04
9	Michael Galley	GM, Environmental Policies Mgr	Mar 04
10	Ken Moxey	GM, Environmental Mgr	Mar 04
11	Brian Setchell	GM ELV coordinator	July 04
12	Brian Setchell	GM ELV coordinator	Nov 04
		Tyres	
13	Michel Cros	Michelin, VP ELT	Nov 03
14	Jamie Randall	Sapphire, Michelin-Lafarge JV, MD	Dec 03
15	Michel Cros	Michelin, VP ELT.	Dec 03
16	Thierry Martin	Michelin UK, Mgr	Feb 04
17	Jamie Randall	Sapphire, MD	Mar 04
18	Murray Hislop	Sapphire , Oldbury Ops Mgr	Mar 04
19	Trevor Coleman	Lafarge, Sales and Marketing Mgr	April 04
20	Bob Wain	Lafarge, Operations Mgr	April 04
21	John Collinson	Lafarge, Westbury Operations Mgr	June 04
		Photocopiers	
22	Malcolm Hemming	Xerox Europe Manager, EH&S,	Nov 03
23	Nick Hawkins	TNT-Xerox Operations Manager,	Nov 03
24	Ray Platts	CoverTronic Ltd General Manager,	Nov 03
25	Dave Bufton	Xerox E,H&S Manager, Mitcheldean	Nov 03
26	Dave Bufton	Xerox E,H&S Manager, Mitcheldean	Nov 03
27	John Evans	Xerox Mitcheldean, Operation Mgr	Mar 04
28	Andreas Krawczik	Covertronic Ltd	June 04
29	Malcolm Hemming	Xerox HQ, Welwyn G C	June 04
30	Jos Hagebols	Xerox , Assets and Prod Returns	Nov 04
31	Jos Hagebols	Xerox, Venray site	Dec 04
32	Ben Bergkamp	Flextronics Ndr Ops Mgr	Dec 04
33	Alain Corneil	Flextronics Ndr SSC Operations	Dec 04
		Secondary interviews (Automotive, Electronics and Policy)	
1	Vincent Kok	Auto Recycling Nederlands	Dec 02
2	Peter Eastland	Nissan, Senior Engineer	Jan 03
3	Paul Fitchett	Nissan, Product homologation mgr	Jan 03
4	Andy Palmer	Nissan, Vehicle Design Director	Jan 03
5	Derek Wilkins	European Metals Recycling,	March 03
6	Louise Morgan	T-Mobile, Environment Advisor,	March 03
7	Jan Mirkowski	T-Mobile, H,S&E Manager,	March 03

8	Steve Franklin	SMMT, Manager	June 03
9	Mike Godfrey	Honda, Chief Eng, HMUK	July 03
10	John Pitts	Volvo UK Environment Manager,	July 03
	John Pitts	Volvo UK Environment Manager,	Sept 03
11	Peter Stokes	VAG and CARE	July 03
12	Geoff Corani	RecommIT, Managing Director,	Nov 03
13	John Setchfield	Engelhardt Ltd, MD	Nov 03
14	Faye Burton	Honda, Environmental Manager	Dec 2003
15	Robert Browett	PSA, ELV coordinator	Dec 2003
16	Steve Norgrove	DTI, ELV policy	Jan 2004
17	Estella Woo	Visteon, Materials Design	March 04
18	Lucy Wright	Nokia, Environmental Manager,	May 2004
19	Annukka Sairanen	HP, UK Environmental Manager,	May 2004
20	Kirstie McIntyre	HP, UK Environmental Programs Mgr	June 2004]
21	Joy Boyce	Fujitsu Siemens, Mgr	July 2004
22		TAssets Management	2003

Other sources

- Environmental reports (Xerox, GME, Lafarge, Michelin, Sapphire)
- Company presentations (Xerox, Autogreen)
- Data on material flow (spreadsheets – Xerox)
- Organograms – Xerox (Venray, Europe HQ, Micheldean)
- Press releases and news reports (on Michelin, Lafarge, Sapphire, Xerox, GME, Flextronics)

Site visit (including photographic records)

- Lafarge (Cauldon and Westbury) and Oldbury - tyre sorting, shredding and incineration
- Xerox, Micheldean and Venray – copier operations, reman., etc
- Autogreen - depollution rigs Bridges - Car processing – depollution rigs etc, Car shredding EMR

Network mapping sessions

	Who	Company	Date
		Cars	
1	Setchell	GM [Autogreen site Daventry)	Oct 03
		Tyres	
2	Jamie Randall, Coleman and Wain	UK Tyre recovery operation by Sapphire	Dec 03
		Mobile Phones	
3	Dominic Wing and Cathy Woodward	Shields UK Fonebak Scheme	April 03
		Photocopiers	
4	Dave Bufton, Malcolm Hemming, Ray Platts	XEROX UK recovery operation [plus link to Venray]	Nov 03

Site observation sessions

To view product recovery operations

	Who	Company	Date
		Tyres	
1	Trevor Coleman	Westbury Cement Works	Nov 03
2	Jamie Randall	Cauldon Cement works	Dec 03
3	Jamie Randall	Oldbury tyre sorting site	Mar 04
		automotive	
4	Geoff Bridges	Bridges, Sussex	Feb 04
5	Chaz Ambrose	Trents, Dorset	Jan 04
6	Derek Wilkins	EMR, Sussex	Feb 04
7	Gaskin	Autogreen, Daventry	Nov 04
		Mobile Phones	
8	Dominic Wing and Cathy Woodward	Shields Fonebak Scheme, Essex	April 03
		Photocopiers	
9	Dave Bufton, Malcolm Hemming	XEROX UK recovery operation and Covertronic operation @ Micheldean	Sept 04
10	Jos Hagebols	Xerox – Flextronics operation @ Venray	Nov 04

Appendix Three Legislation summary and comparison

The ELV and WEEE Directives - a comparative analysis

The ELV directive as written into European law on the 18th September 2000 and is being implemented by the member states, although the exact details of schemes etc are still to be decided.

The WEEE Directive is still in draft form and the final version is likely to be passed into EU law in March 2003.

Directive section	ELV	WEEE (Draft - likely passed in March 2003)	Comment
Objectives	Prevent and reduce the disposal of waste and improve the environmental performance of the operators	Prevent and reduce the disposal of waste and improve the environmental performance of the operators	Virtually the same text in both
Scope	All ELV minus some special purpose vehicles and limited application to 3 wheelers	Covers all the EEE defined in the Annex 1B. Not applied to military hardware.	Just defines the product groups
Definitions	Very similar definitions	Very similar definitions	Both refer to directive 75/442/EEC for definitions of recovery and disposal and the type of waste either ELV or WEEE
Product design	Design in dismantling, recycling and recovery ability. Restrict hazardous substances and increase the recycled content of vehicles	Ensure nothing prevents re-use. Design in dismantling, recycling and recovery ability	No requirement to include recycled material in EEE. ROHS[36] Directive will limit hazardous substances from the EEE by restricting stated chemicals from products
Collection	Economic operators set up the system Authorised treatment centres Certificate of destruction - linked to de-registration Delivery to treatment centre at no cost to the end user (even if negative value) Producers meet all, or significant part of take-back costs	[Recycling not mandatory, but must minimise as municipal waste] Set up free of charge scheme to collect [but not decided how yet] Can return EEE one for one to distributor, but MS[37] can opt out of this Producers can set up individual or collective take-back systems. If H&S risk can refuse to take the EEE back Treated at authorised sites unless re-used as a whole By 31/12/02 collect at least 4kg of EEE per inhabitant	The main difference is that take back of EEE is not mandatory, although must meet 4kg target. This is means that EEE could be discarded in domestic waste as no incentive. The ELV system incentivises individuals to take back or they will continue to pay tax on the car. But most large products would not fit into the wheelie bin anyway, so take to municipal site which will have the facilities to collect EEE.
Treatment	Correct storage. Licensed sites by competent bodies. Inspection of sites. ELVs must be stripped of selected parts/materials which are hazardous or contaminate shredder residue. Encourage EMS of sites.	Producers (or 3rd parties) to set up systems to provide recovery and recycling of WEEE. Can be collective systems. Must have permits and be inspected. Can export, but only counts as recovered if have	Basically both have to be depolluted, before sent for material recovery/recycling at permitted sites which are regularly inspected.

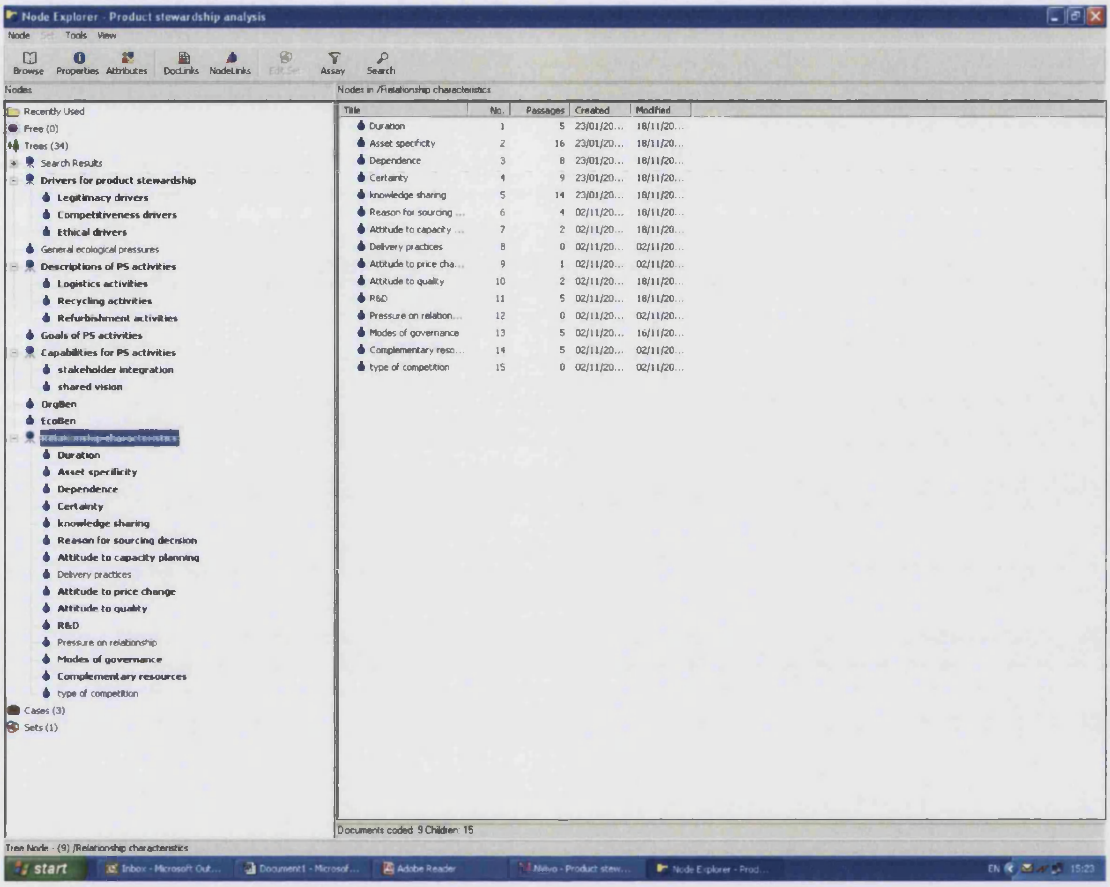
[36] Restrictions on Hazardous Substances Directive
[37] Member State of the European Union

		equivalent systems in place. Must strip various parts viewed as hazardous e.g. 10cm^2 PCB[38]s, 100cm^2 LCD[39]s and batteries. Encourage EMS of sites also.	
Re-use & Recovery	Sets the rates for recovery in 2006 at 85% recovery and 80% reuse/recycling then at 2015 at 95% recovery and 80% reuse/recycling. Design type approval for dismantlability, recoverability and recyclability in Directive 70/156/EEC amendment.	Sets the rate for IT/mobile phone recovery in 2008 to be 75% recovery and 65% for reuse/recycling. Mass to be recorded on entering treatment, exiting treatment and entering recycling facilities. Design covered in Article 4, MS to encourage DfD[40] and not inhibit re-use through design limitations.	Similar broad requirements for the levels of recovery and recycling of parts and materials as well as timescale. Less stringent requirement on design aspects for recoverability and dismantling for EEE.
Information	Coding of parts to show which can be re-used/recovered. Producers including part makers must provide dismantling and recycling information. Economic operators should provide info on the design of vehicles, treatment of ELVs, development of ways to re-use, recycle and recover and progress toward the recovery and recycling targets. This should be included in the marketing of vehicles.	MSs must ensure users know about non-disposal and the facilities available, the environmental risks. Producers must mark products. Producers must provide information on dismantlability and recovery to not inhibit this process (manuals and CD-ROMs). MSs must provide a register of producers with quantities of product put on market and amount re-used/recovered and send a report to the EC on the achievement of targets.	
Financing	Producers must take all or a significant part of the cost for the free-take back (costs of depollution and recycling when vehicle has a negative value).	Producers can take individual responsibility or join a collective scheme. Finance contributions will be calculated on the basis of market share (from databases held in each MS).	

[38] Printed circuit board
[39] Liquid Crystal Display
[40] Design for Disassembly or Dismantling

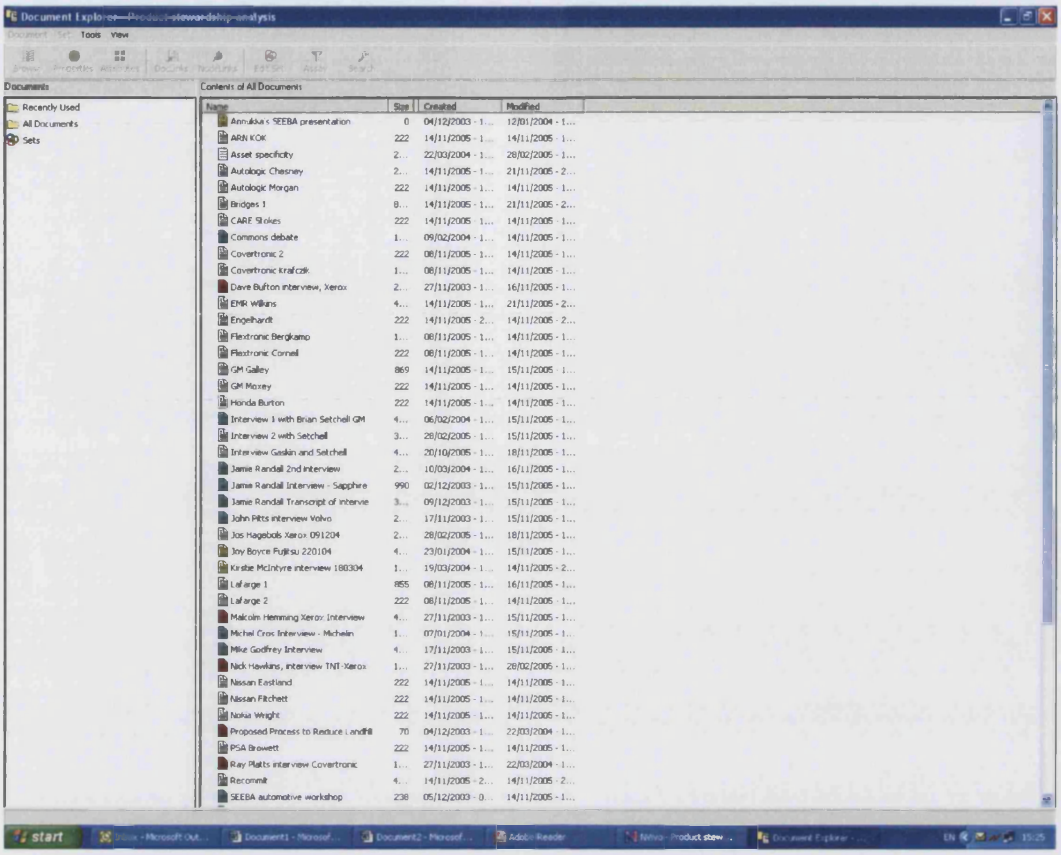
Appendix Four Examples from Qualitative analysis method using NVivo

Example of nodes used in the analysis using NVivo

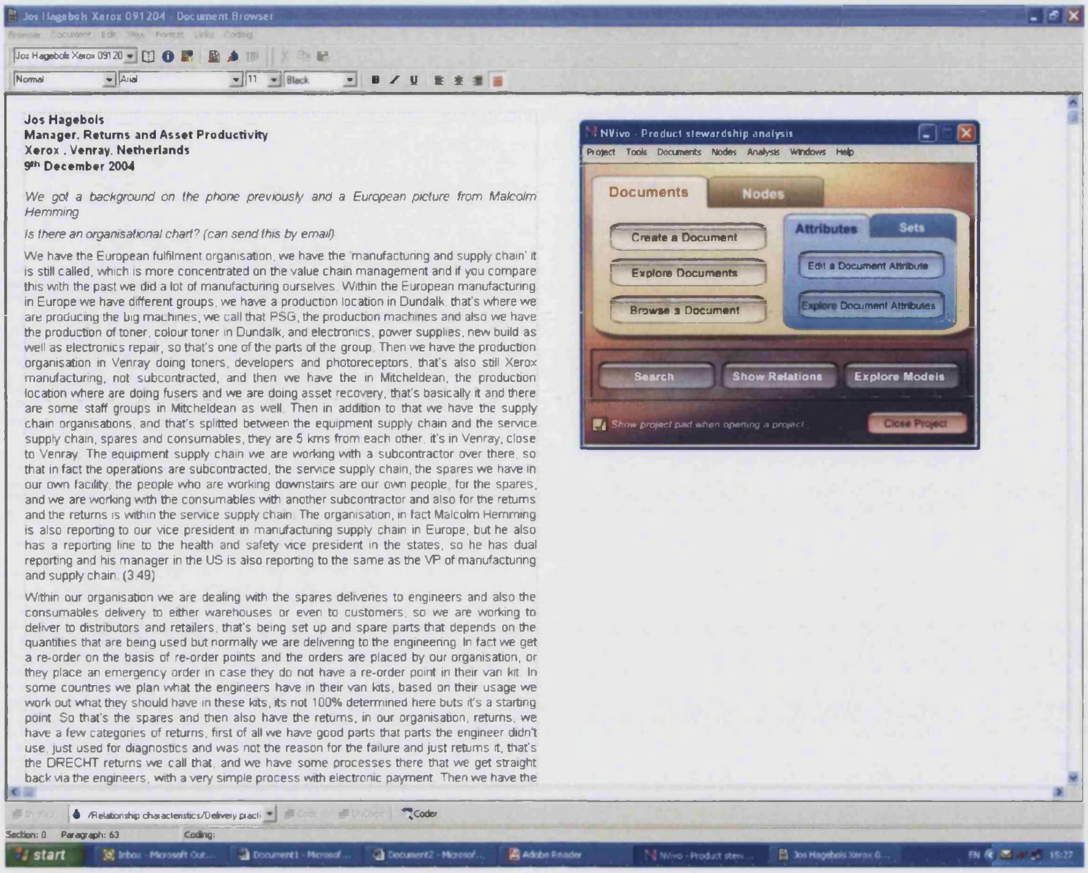


Within NVivo, the nodes, also known as codes in the qualitative methods literature, can be assigned to particular sections of texts in the literature. Therefore the interview transcripts and notes from discussions and site visits were assigned to particular nodes. These nodes were produced according to known concepts derived from the literature, for example the nodes for Relationship characteristics shown above split into 15 sub nodes, that were found in the literature to describe relationships in terms of collaboration. Text in NVivo relating to the relationship was allocated to a specific node depending on how well it matched the node description.

Where nodes were underspecified in the literature, for example, product recovery capabilities, new nodes were generated in NVivo to classify text concerning these capabilities. This allowed the differentiation, and development of new capability descriptions, used in the data analysis, to show case differences.



Example of database of transcripts and notes


Jos Hagebols
Manager, Returns and Asset Productivity
Xerox , Venray, Netherlands
9th December 2004

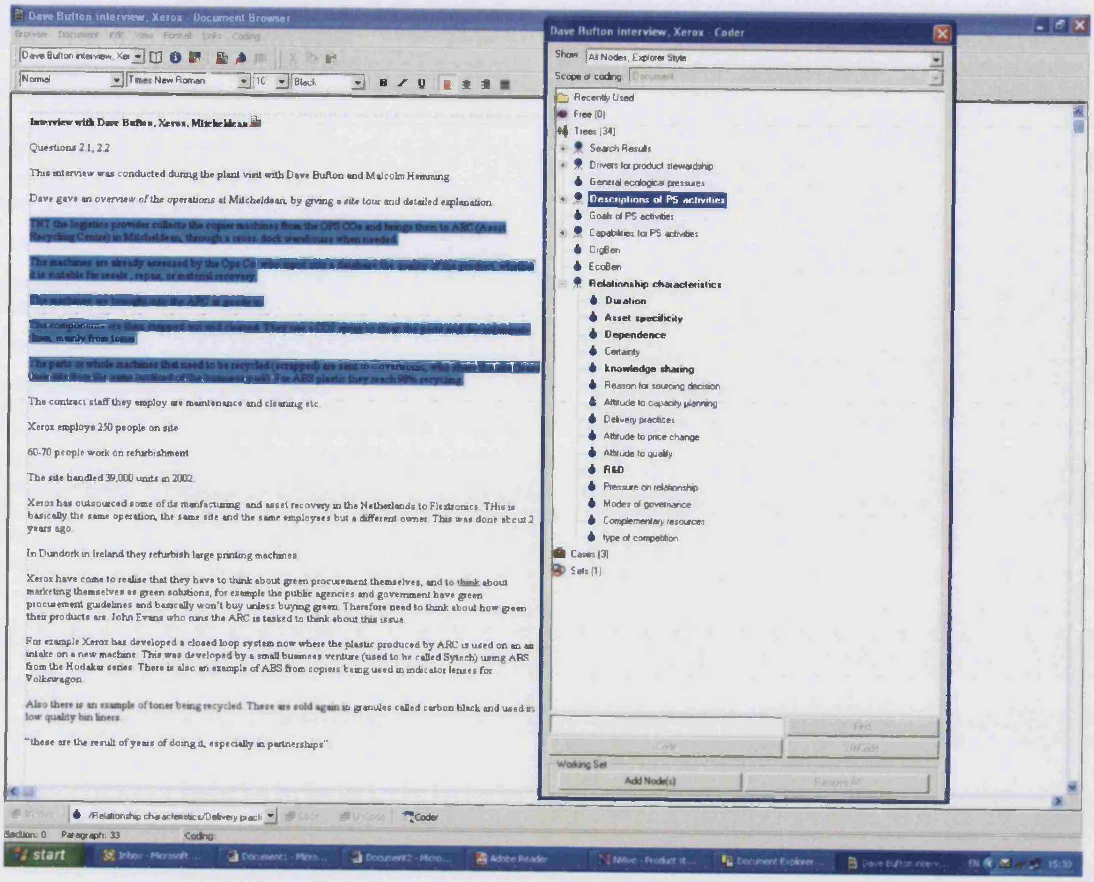
We got a background on the phone previously and a European picture from Malcolm Hemming

Is there an organisational chart? (can send this by email)

We have the European fulfilment organisation, we have the 'manufacturing and supply chain' it is still called, which is more concentrated on the value chain management and if you compare this with the past we did a lot of manufacturing ourselves. Within the European manufacturing in Europe we have different groups, we have a production location in Dundalk, that's where we are producing the big machines, we call that PSG, the production machines and also we have the production of toner, colour toner in Dundalk, and electronics, power supplies, new build as well as electronics repair, so that's one of the parts of the group. Then we have the production organisation in Venray doing toners, developers and photoreceptors, that's also still Xerox manufacturing, not subcontracted, and then we have the in Mitcheldean, the production location where are doing fusers and we are doing asset recovery, that's basically it and there are some staff groups in Mitcheldean as well. Then in addition to that we have the supply chain organisations, and that's splitted between the equipment supply chain and the service supply chain, spares and consumables, they are 5 kms from each other, it's in Venray, close to Venray. The equipment supply chain we are working with a subcontractor over there, so that in fact the operations are subcontracted, the service supply chain, the spares we have in our own facility, the people who are working downstairs are our own people, for the spares, and we are working with the consumables with another subcontractor and also for the returns and the returns is within the service supply chain. The organisation, in fact Malcolm Hemming is also reporting to our vice president in manufacturing supply chain in Europe, but he also has a reporting line to the health and safety vice president in the states, so he has dual reporting and his manager in the US is also reporting to the same as the VP of manufacturing and supply chain. (3.49)

Within our organisation we are dealing with the spares deliveries to engineers and also the consumables delivery to either warehouses or even to customers, so we are working to deliver to distributors and retailers, that's being set up and spare parts that depends on the quantities that are being used but normally we are delivering to the engineering. In fact we get a re-order on the basis of re-order points and the orders are placed by our organisation, or they place an emergency order in case they do not have a re-order point in their van kit. In some countries we plan what the engineers have in their van kits, based on their usage we work out what they should have in these kits, its not 100% determined here buts it's a starting point. So that's the spares and then also have the returns, in our organisation, returns, we have a few categories of returns, first of all we have good parts that parts the engineer didn't use, just used for diagnostics and was not the reason for the failure and just returns it, that's the DRECHT returns we call that, and we have some processes there that we get straight back via the engineers, with a very simple process with electronic payment. Then we have the

Example of a transcript



Example of coding